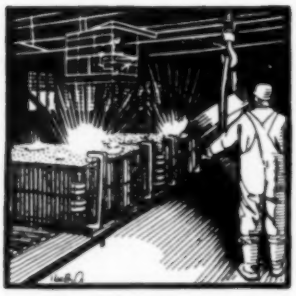


THE FOUNDRY

for March

Wanted GOOD IDEAS

WHOEVER stated the fact that a monopoly of ideas could not exist knew the fundamental truth of human progress. Had brains been so circumscribed and all invention held close within a small group or class, skin suits would still be the mode in the 1935 Easter parade while Azukar or Cavalcade would furnish the fastest means of travel. A peculiar and fundamental fact about ideas and particularly those which represent major advancement is the manner in which they grow in worth as they are put in circulation. The very speed by which modern mechanical arts have developed, all within a century, is evidence of this. And the greatest advance has been in these crafts, trades, or industries where the interchange of ideas has been facilitated.

In the foundry industry, the journeyman molder first carried ideas from shop to shop across the country following the Civil war. That was the first step forward in castings manufacture. The establishment of THE FOUNDRY more than 40 years ago stimulated and quickened the circulation of ideas among those small individual plants that previously had been isolated and insulated. That insulation against the interchange of ideas further was broken down by the development of local and national associations, and with the improvement of means for exchanging ideas the industry grew and developed with remarkable speed.

The past five years, following the pattern of all similar periods in the history, undoubtedly has been productive of much advancement. Evidences of this are found in early announcement of new machines and equipment, and in the reports of metallurgical progress peculiar to the foundry industry. Again, THE FOUNDRY seeks to stimulate and speed the interchange of ideas, particularly those that are to be found in the various manufacturing departments of castings plants. This is the basic reason for the Foundry Progress Contest, announced on page 41 of this issue. To find new practices, to develop new sources of practical ideas and to recognize, on behalf of the industry, those who set in circulation a new currency of the greatest intrinsic worth, ideas.

Skill Holds THE KEY

UNEMPLOYMENT figures, always debatable and still unpleasantly depressing, fail to show the picture which lies ahead. The main obstacle to re-employment in many industries, the veritable key log of the jam, lies in the acute shortage of skilled men. The inability to secure trained men in comparatively small numbers may prevent the early re-employment of a far greater number of unskilled workers.

As predicted by this magazine more than eight months ago, the shortage of skilled men is tightening. In those regions where certain types of demand are bringing heavy orders to foundries, the limiting factor on production is the lack of trained men. The answer has been found in some cases in mechanical equipment, while in others there is no answer.

Training is badly needed. This is true of the immediate future and over the long pull. The lapse of five or six years has left a serious gap in the ranks of able foundrymen. Some ground must be regained through re-training those who have lost a measure of deftness and ability. New employes, whether of the apprentice age or older, must be given systematic instruction. The job before the foundry industry is one of rebuilding manpower. It partakes of both reconstruction and building anew and the work devolves upon each shop, each community and the industry at large. Those plants which during the past ten years have had a program of training have a head start. Means must be found to spread the opportunity more broadly and to provide for the next generation a basis of preparation in foundry technique.

Fig. 1—Furnace roof is removable to permit charging with the crane

Specializes in Alloy Steel Castings

By PAT DWYER

AMONG the many kaleidoscopic changes in the foundry industry during the past 30 years, perhaps none is more spectacular than the evolution and growth of the steel casting branch. Steel castings were made in the eighties and nineties of the past century, but only to a limited extent, in comparatively small quantities and only in a few plants. A potential field was in existence, but as with other potential fields, few men had the necessary vision to see it, and among these men, a smaller number had the initiative and courage to attempt to exploit it.

The present generation is familiar with the extent to which the steel foundry industry has expanded in recent years. During the past few years in keeping with the universal curtailment in consumption of all materials and the consequent reduction in operating activities, production of steel castings in the United States has been halted in the constant expansion which characterized the growth for the preceding quarter century or more.

About 30 years ago David Evans, engaged for several years in the prosaic business of selling pig iron, decided that there was a promising opening in Chicago for a steel foundry. Accordingly, he organized a company and established a small plant on part of the site now occupied by the plant of the Chicago Steel Foundry Co. At first the operation of this plant was regarded more or less as a side line to his regular business of selling pig iron, but the enterprise prospered to such an extent that in a short time he severed his connection with the pig iron interests and devoted all his time to the development of the lusty young infant steel foundry.

In the original modest installation the steel was melted in crucibles. These were followed by converters and the converters were abandoned later in favor of the electric furnace process. Steady expansion of the business necessitated many changes and rearrangements in plant layout, culminating several years ago in the present foundry approximately 600 feet in length, with auxiliary buildings, pattern shop, pattern storage, repair and maintenance shops,

Fig. 2—Kiln end casting in continuous service for over three years at temperature of 1950 degrees Fahr.

office, etc., occupying an extensive plot of land at 37th street and Kedzie avenue, adjoining the main line of the Chicago & Alton railroad.

In line with modern production methods the flow of materials is in a straight line from east to west. The melting department is at the east end of the main bay and the castings are shipped from the west end either by truck or by rail. The center or main bay is spanned by three 10-ton cranes and the melting equipment includes one 3½ and one 5 ton furnace. The furnaces are of the direct arc type, with the tops removable to permit charging the material from a drop bottom bucket. One man makes up the charges in the bucket located on a scale below the floor level. The craneman then picks up the bucket and deposits the charge in the furnace.

Sand Handled Mechanically

Molds are made on approximately half the floor space in the main bay and in an adjoining bay. After the castings are poured they are shaken out over a grating in the center of the shop. A belt under the grating carries the sand to a sand conditioning apparatus in the side bay. Here the sand is elevated to the top of the apparatus and falls through a screen which removes scrap and hard lumps of sand which escaped the first coarse screen on the floor.

Screened and aerated sand falls into a hopper or magazine provided at the bottom with a measuring device. The operator pulls a lever and a measured quantity of sand falls into a 6-foot diameter muller made by the National Engineering Co., Chicago. The attendant adds the required amount of binding material and water after which the sand is discharged into sheet steel boxes which may be conveyed by truck or crane to any desired location on the molding floor.

Monorails equipped with electric hoists serve the jolt rollover molding machines made by the Herman Pneumatic Machine Co., Zelienople, Pa. The molds from one of these machines in the side bay are loaded on a wide gage track which carries them into the main bay for pouring purpose.

Fig. 3—Small castings are moved in trailers attached to an electrically operated tractor

Fig. 4—An electrically operated transfer car expedites the transfer of castings into and out of the electric annealing furnace shown at the right

Core and mold ovens are located close to the core making department which occupies space in the center of the third or north bay. The larger cores, for example those for melting pots, are dried in the mold oven, while the smaller cores are dried in rack type ovens, three fired with electric current and the fourth with oil. Two smaller gas fired ovens are located at the opposite end of the core room.

Ovens Heated Electrically

The remainder of this bay is taken up by two electrically heated annealing furnaces where special heat treatment is applied to the many varieties of alloy steel castings in which the company specializes. The rails from each furnace extend to a point outside where they meet a depressed transverse track as shown in Fig. 4. With this arrangement it is possible to load two cars in the casting cleaning department while two other carloads of castings are undergoing treatment in the furnaces. A loaded car is pulled out of the furnace and placed on the electrically operated transfer car which then moves forward until the tracks on the car come in line with one of a pair of tracks on the cleaning floor. The car of treated castings is pulled off, the transfer car is shifted to a position in front of the second track and the car load of untreated castings is run on to the transfer car, which then moves in the opposite direction until it comes in front of the annealing furnace. The car then is pulled into the furnace with a pinion and rack.

Castings are made in a wide range of compositions including plain carbon steel and various alloy steels. The company has developed two special alloy steels, one to resist high temperatures and the other to resist wear, shock and

Fig. 5—All the molds are shaken out in one area from which later the sand is conveyed to various points by grab bucket

abrasion. Extreme care exercised in the selection of raw materials and in the subsequent processes of melting, pouring, molding, cleaning and heat treatment, is reflected in the surface appearance of the castings and in the physical properties. For example in a series of 30 carbon steel heats, maximum physical properties showed: Tensile strength 89,400 pounds per square inch; yield point 44,150 pounds per square inch; elongation 33.5 per cent; reduction in area 50.6 per cent. Loss through defective castings averaged 2.15 per cent.

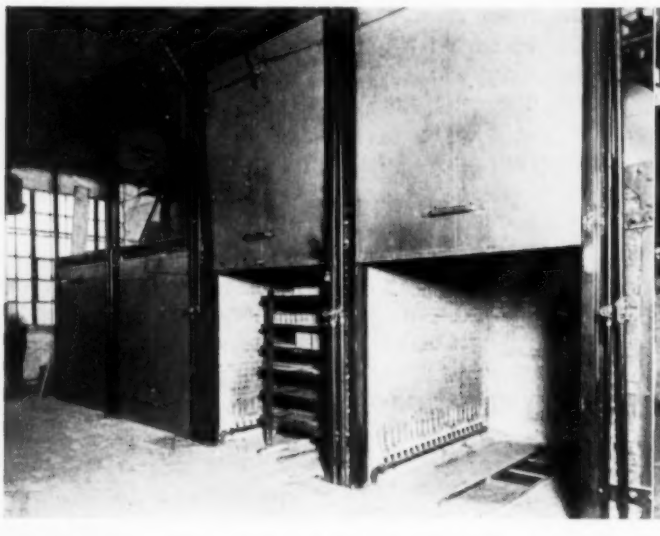
A nickel chrome alloy steel lends itself readily to various forms of heat treatment. For example in dipper teeth for excavating machinery the points of the teeth are raised to a brinell hardness of 350 to 400 while the remainder of the casting shows a hardness of 175 to 200. It is claimed that the most advantageous feature of that metal is adaptability for use under varying conditions and that it readily is machinable. Typical physical properties of three castings taken from the same heat and given different heat treatments are shown in the accompanying table.

The steel contains from 1 to 2 per cent nickel and from 0.75 to 1.00 per cent chromium and on a simple anneal shows a tensile strength of 95,000 pounds per square inch, yield point 60,000 pounds, elongation in 2 inches 24 per cent and 37 per cent reduction in area.

The kiln end casting weighing 7000 pounds shown in Fig. 2 is typical of the high temperature resistant castings made by the company from a chrome-nickel-silicon steel alloy. This casting has been in continuous service for over 3 years at a temperature of 1950 degrees Fahr. Over a period of many years a great deal of valuable data on the composition, design and production of heat resistant castings has been accumulated.

A grid for use in a heat treating furnace may be cited as an example of the importance of design in securing satisfactory service and long life. Formerly that casting was a corrugated solid plate with a half flange at each end. Loaded with heavy forgings and charged into an oil fired furnace of the pusher type, the corrugated pans warped and developed cracks which rendered the castings unfit for further service. The design was changed to a grid with a full flange at both ends. Many openings 2 x 4 inches through the plate permit the rapid absorption of heat through all parts of the load while a minimum amount of material is in contact with the grid.

An ingenious method is practiced in the production of feed screws (*Please turn to page* 59)



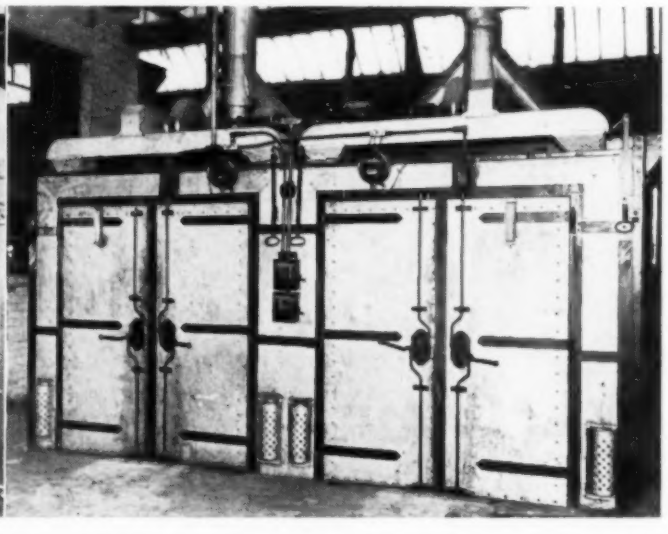


Fig. 6 (Left)—Small cores are loaded on racks and dried in a battery of oil fired ovens. Fig. 7 (Right)—Cores in this battery of ovens are dried by electric heat

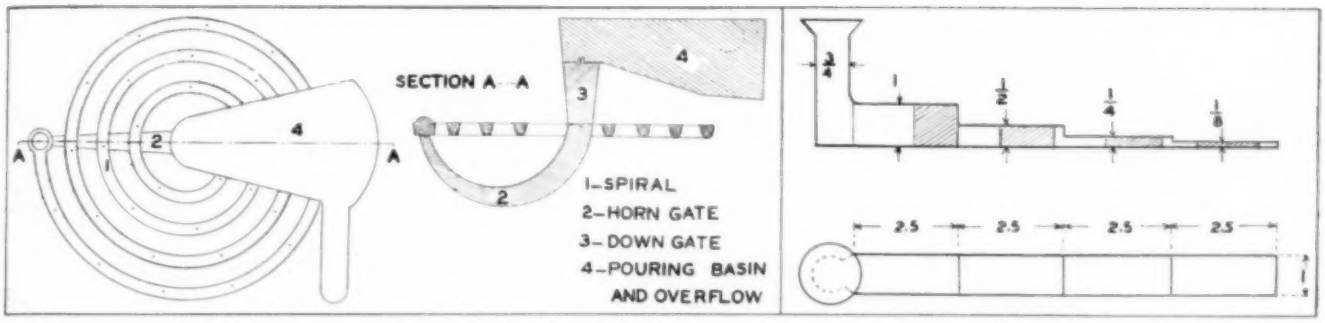


Fig. 1 (Left)—Spiral casting for determining running quality of molten metals in a sand mold. Fig. 2 (Right)—Stepped-bar casting. Shaded portions cut from bars were used in density determinations. All dimensions in inches

Melting Conditions of Aluminum

Tests show effect of maximum temperature on running qualities of sand cast metal

By A. I. KRYNITSKY and C. M. SAEGER JR.
Bureau of Standards

A PRACTICAL method for determining the running quality of metals previously was described by the authors—*Transactions*, A. F. A. 1931, page 513. It consists essentially in pouring, under carefully controlled, conditions, a spiral casting of relatively small cross-section of the design shown in Fig. 1. The length of the spiral obtained under a given set of conditions is a numerical measure of the running quality of the metal under these conditions. The designation, *good* running quality or *high* running quality, is to be understood as indicating that the metal produced long spirals.

In making some experiments designed primarily to demonstrate the possibilities of the method, it had been observed that the running quality of commercial aluminum, poured at a given temperature, depended on the maximum temperature to which the metal had been superheated previous to pouring. In dry sand molds it was found that the lengths of spirals, poured at a given temperature, were in the inverse order of the three maximum temperatures, in this case 1380, 1450 and 1540 degrees Fahr. to which the metal had been superheated. In green sand molds this order was not preserved exactly, the 1540 degrees Fahr. maximum heating temperature resulting in a spiral of length shorter than that obtained for 1380 degrees Fahr. and longer than that obtained for 1450 degrees Fahr. The present work was undertaken to study that effect more systematically but had to be discontinued before completion. It is believed, however, that the results obtained, though incomplete and inconclusive, will be of interest to many men engaged in the production of aluminum castings.

Two grades of ingot aluminum, which will be designated as pure (silicon, 0.07 per cent; iron, 0.15 per cent; copper, 0.01 per cent and aluminum, 99.8 per cent) and commercial aluminum (silicon, 0.15 per cent; iron, 0.50 per cent; copper, 0.12 per cent and aluminum, 99.2 per cent) were used in this work and some tests also were made with an alloy of 8 per cent copper with the commercial aluminum.

Temperature Measured with Thermo-Couple

A charge of 40 pounds of aluminum, or of the aluminum-copper alloy, was melted in a plumbago crucible in either a high frequency, induction furnace or in a gas-fired furnace. The molten metal was heated to a maximum temperature of either 1380 or 1560 degrees Fahr., measured in the furnace, held at the temperature for 1 minute (except in the tests later referred to as prolonged heating in which the metal was held for 30 minutes at the maximum temperatures), and allowed to cool slowly.

Temperature was measured with a chromel-alumel thermo-couple in a porcelain insulating tube and protected with a porcelain protection tube inside an iron secondary tube coated with alundum cement. The cold junctions were kept at 0 degrees Cent. and the e.m.f. measured with a portable potentiometer.

Prior to pouring the first casting, a sample of

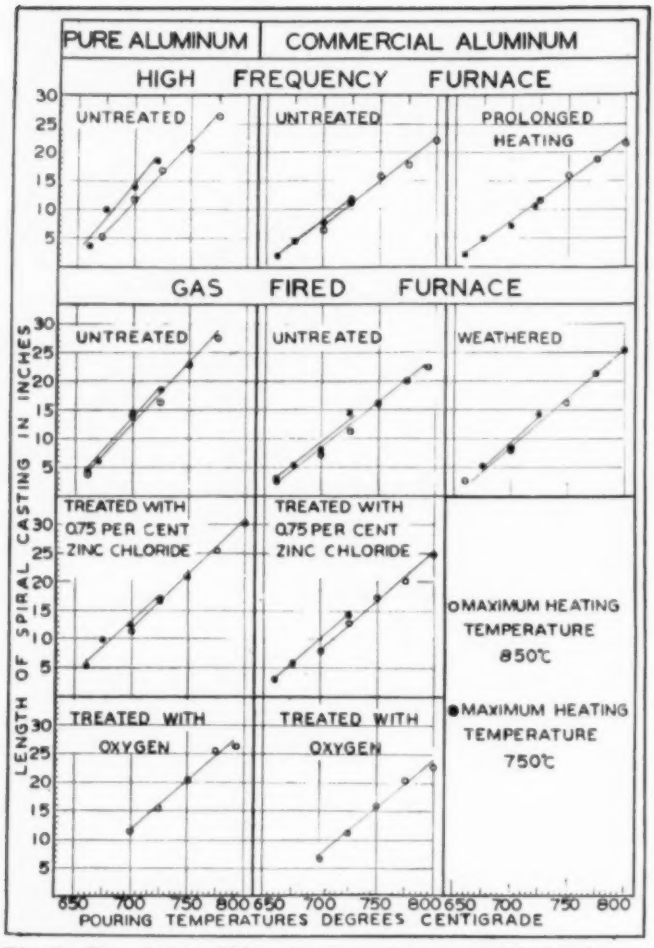


Fig. 3—Running qualities of pure and commercial aluminum, treated and untreated, heated in high-frequency induction and gas fired furnaces

the molten metal at a known temperature was taken from the crucible by a graphite immersion device. That device, containing the liquid sample, was then placed in a dry sand mold to secure a slow rate of cooling. Longitudinal sections of the samples taken in that manner were etched deeply for inspection by visual examination.

Temperature of the metal in the crucible then was measured and a quantity of metal poured into a sand ingot mold to eliminate an excessive temperature drop due to contact with the cold lip of the crucible when pouring the test specimens. Two types of castings were poured, a spiral and the stepped bar casting shown in Fig. 2. The metal then was allowed to cool until the next desired pouring temperature had been reached, when another spiral and stepped bar casting were poured as before.

The stepped bar castings were sectioned longitudinally and specimens for density determinations taken from one-half of the casting at the positions shown by the shaded sections of Fig. 2. Density determined on the half-inch section of the bar was considered representative of the metal cast. The remaining half of the stepped bar was etched deeply for visual examination as in the first case.

All castings were made in green sand molds made of Albany 00 sand tempered to 6 to 7 per cent of moisture. The molds were levelled and care was taken always to employ the same pouring height and rate.

To secure information which might throw some light on the cause of the behavior of aluminum which had been superheated, special treatments were given to a number of the melts. Some were treated with various amounts of zinc chloride, which were introduced into the liquid metals by a small inverted graphite crucible. The side wall of the crucible was perforated to facilitate the reaction of the chloride and the molten metal. In other melts oxygen was passed for 5 minutes through the molten aluminum at 1562 degrees Fahr. to promote formation of aluminum oxide. Finally some tests were made using commercial aluminum, which had been exposed to the weather continuously for a period of 75 days.

Lengths of the spirals obtained under various conditions are plotted in Figs. 3, 4 and 5 while selected values taken from the straight lines drawn through the plotted points are given in the accompanying table.

It should be pointed out that the series of points corresponding to any given straight line are observations obtained with a single crucible of metal. Each point represents the pouring of

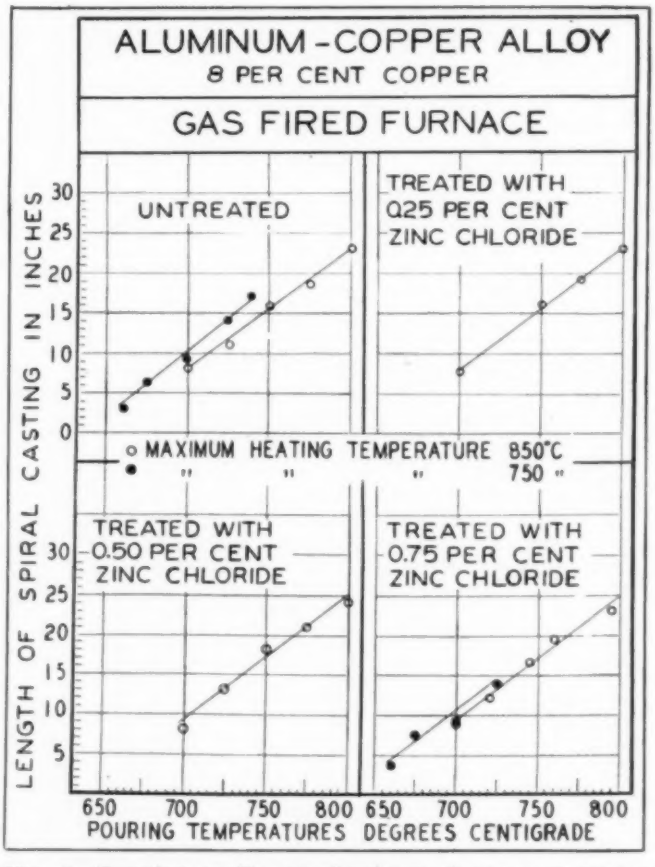

ALUMINUM-COPPER ALLOY
8 PER CENT COPPER
GAS FIRED FURNACE
UNTREATED
TREATED WITH 0.25 PER CENT ZINC CHLORIDE
○ MAXIMUM HEATING TEMPERATURE 850°C
● " " " 750 "
TREATED WITH 0.50 PER CENT ZINC CHLORIDE
TREATED WITH 0.75 PER CENT ZINC CHLORIDE
LENGTH OF SPIRAL CASTING IN INCHES
POURING TEMPERATURES DEGREES CENTIGRADE

Fig. 4—Running quality of aluminum, 8 per cent copper alloy melted in gas fired furnace

one spiral, and successive points represent successive pouring from the same crucible, where all conditions, save the pouring temperature, are substantially the same. Thus, the points in one such series probably are located relative to each other with far greater precision than could be expected if each point were obtained from a different melt. A few check heats would have thrown some light on the reproducibility of the slopes of these straight lines, but unfortunately the work had to be discontinued before this was done.

There can be but little doubt that for a given pouring temperature the metals studied have a higher running quality when they have been superheated to 1380 degrees Fahr. than when they were superheated to 1560 degrees, since no exception to the rule has been found. The magnitude of that effect has not been established accurately but seems, on the average, to correspond to about 10 per cent in spiral length.

From the accompanying table and Figs. 3, 4 and 5, the following additional conclusions seem warranted:

a. The relation between pouring temperature and length of spirals is linear from 1220 to at least 1470 degrees Fahr.

b. The running quality of the pure aluminum, regardless of how the metal is treated, is markedly superior to that of the commercial aluminum.

c. Treatment with zinc chloride apparently has little or no effect on the running quality. The effect obtained was slightly beneficial in the case of the commercial aluminum and alloy but detrimental in the case of the pure metal. The differences are too small, however, to have any real significance.

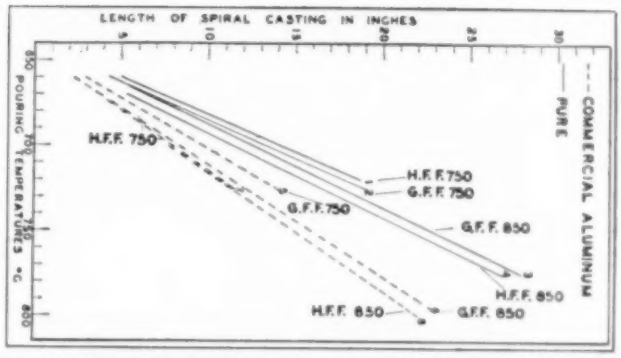


Fig. 5—Running qualities of pure and commercial aluminum heated in high frequency induction and gas fired furnaces

d. Treatment with oxygen had little or no effect in the case of commercial aluminum but produced shorter spirals in the case of the pure metal.

e. The weathered commercial aluminum behaved the same as the unweathered material.

f. Commercial aluminum heated to 1380 degrees Fahr. in the gas-fired furnace produced spirals markedly longer than the same metal heated to 1380 degrees in the induction furnaces. This single instance is scarcely sufficient to establish with any certainty an effect due to the type of furnace as the observed effects obtained in the other three instances where comparison is possible, were small and random.

g. Visual examination disclosed that the metals treated with oxygen contained a great number of both large and small cavities.

Density of castings made of commercial aluminum invariably was greater than that of castings made of pure aluminum cast under comparable conditions. However, the differences evidently were due in large part to the presence of cavities in the pure metal and no definite correlations could be found between density and other factors.

All samples taken by the immersed crucible method as well as a number of the stepped bars of pure aluminum formed large internal pipes, whereas in the case of the commercial aluminum all the stepped bars and most of the immersion samples were free from such pipes.

The microstructures suggested that porosity in the pure aluminum was mostly in the (*Please turn to page* 60)

Running Quality of Pure And Commercial Aluminum

Lengths of spirals in inches

Pouring temperature	High frequency furnace				Gas-fired furnace									
	Untreated maximum temperature		Metal held for 30 minutes at maximum temperature		Untreated maximum temperature		Treated with oxygen at maximum temperature	Weather exposed ingots maximum temperature		Treated with zinc chloride				
										0.75% $ZnCl_2$ maximum temperature		0.50% $ZnCl_2$	0.25% $ZnCl_2$	
												maximum temperature		
	750° C	850° C	750° C	850° C	750° C	850° C	850° C	750° C	850° C	750° C	850° C	850° C		
PURE ALUMINUM														
°C														
700	14.1	11.4	.....	.....	13.3	12.5	11.8	.....	.....	12.7	12.0	.....	.....	
750	25.6	21.5	.....	.....	24.6	23.0	20.2	.....	.....	21.2	21.0	.....	.....	
COMMERCIAL ALUMINUM														
700	7.9	7.6	8.2	8.2	9.5	8.2	7.1	9.3	8.8	10.2	8.5	.....	.....	
750	15.0	14.8	15.4	15.4	18.0	15.8	15.3	18.5	17.0	18.8	16.8	.....	.....	
ALUMINUM-8 PERCENT COPPER ALLOY														
700	.....	.....	.....	.....	10.0	7.9	.....	.....	.....	10.3	9.2	8.8	8.0	
750	.....	.....	.....	.....	18.4	15.4	.....	.....	.....	17.5	17.0	16.8	15.6	

Fig. 1—Striking example of large steel casting poured in green sand mold

Green Sand for Steel Castings

Where proper precautions are observed large work is poured in green sand

By WILLIAM ROSE

POSSIBILITIES of green sand in steel molding practice are unlimited and the benefits to be derived therefrom are highly lucrative. What green sand really is or was does not matter, unless we can visualize machined and pressure castings totally free from defects formerly experienced and attributed generally to wild metal, or improperly deoxidized steel. Of course this does not mean that inferior metal may be used or that rusty chills or nails are not trouble makers. The thought to keep foremost is that all precautions are not wasted or useless. They are quite necessary either with green or dry sand.

Green sand is a synthetic sand reclaimed successfully. It should be bonded properly and milled or mulled sufficiently to distribute the organic binder and fire clay coating the grains of sand, causing them to cohere, be protected and finally, at the proper time, not break down under temperature, but lose sufficient binder to permit shrinkage in the mold and prevent shrinks and cracks, which in many instances are attributed to design and metal conditions.

Contrary to generally accepted opinion, green sand will not pull down as quickly as dry sand. The writer has observed the pouring of rolls and large housings weighing tons, used in rolling

Fig. 2—A green sand mold greatly facilitated contraction of this intricate casting made up of heavy and light sections

mills, and failed to see green sand fail, regardless of the large, flat surfaces or the long time necessary to fill a large mold, particularly where the metal had a long distance to travel, from 25 to 30 feet when gated at one end.

Green sand that is green sand properly prepared, is practically impervious to the erosive action of steel when poured tangentially, as for example in the cylinder shown in Fig. 1, 25 feet in length and 30 inches diameter. This casting was poured on end with a gate at the extreme bottom. After machining, not only was it free from sand pits and sand inclusions, but was tested successfully many times beyond its requirements.

Steel castings made in green sand molds are free from the defect so often experienced in dry sand castings and known as internal strain. For that reason many castings made in green sand molds do not need to be annealed. However, the annealing feature hinges to some extent on the purpose for which the casting is intended.

The accepted practice of ramming a green sand mold softly to prevent the metal from blowing is the lesser of two evils. It necessarily will result in round corners and edges, swells and over weight castings. Soft sand around the gates will produce dirt in the casting. The sand is not dense or solid enough to stand the wash or erosion of the metal which must flow through at comparatively high speed until the mold is filled. Green sand, either skin dried or otherwise, with the proper permeability and moisture content, may be rammed exceedingly hard. The resulting casting will be square cornered, true to pattern and weight, free from dirt, porosity and pits, provided of course the metal is deoxidized properly and thoroughly.

Among the precautions observed by steel casting manufacturers to prevent dirt from entering the casting is the practice of pouring the steel through a gate enclosed in dry sand cores This precaution is not necessary where the refractory quality of the cores is not as good as the green sand.

However, it is practically impossible on a production basis to be assured of good, hard, even ramming around a gate stick. In many instances oil sand gate cores and funnels prevent the wash of dirt and disturbance in the mold.

There is some controversy as to what type of sand originally is used to produce good castings in green sand molds. The author favors a washed, graded, round sand purchased in a dry state and screened so that the foundry receives only that which remains on a 60-mesh screen. The more open and clean the sand before it is mulled, the more likely it is to have the so called burned-on appearance on the casting. The hot metal penetrates between the open grains and the resulting casting appears to be rough and grainy. However, this is not detrimental, but makes a cleaner and sounder casting from the skin into the heart.

Instead of failing while the mold is being poured, green sand improves in resistance to the action of the hot metal because the various bonds are not weakened or burned out as in dry sand. New sand facing will not burn on more than old sand, provided of course the old sand has the proper permeability or the same as the new sand. Old sand properly cleaned has the same refractory qualities as new sand. When old sand does break down and the grain size becomes too small to be of value, the cleaning system will dispose of the undesirable.

Fig. 3—Green sand showed no sign of pulling down on this long casting poured through a gate at one end

Green sand will run year in and out without any grief, except possibly a leak in the reclamation system. A hole in the screen will allow large particles to pass through. The blower system may not take out all the dust or fines. In certain instances the system worked so well that it was necessary to add fines when the permeability exceeded 400.

Green sand molds will stand for weeks without deteriorating. Molds six weeks old, instead of drawing moisture were as dry and hard as dry sand and when poured, produced beautifully clean, sharp edged castings. Low permeability is one of the worst features encountered in green sand practice.

Manganese steel castings can be produced successfully in green sand molds much more economically than by the use of molds in many cases made entirely in cores. Regardless of the metal, the proper preparation of the green sand will produce good (*Please turn to page* 60)

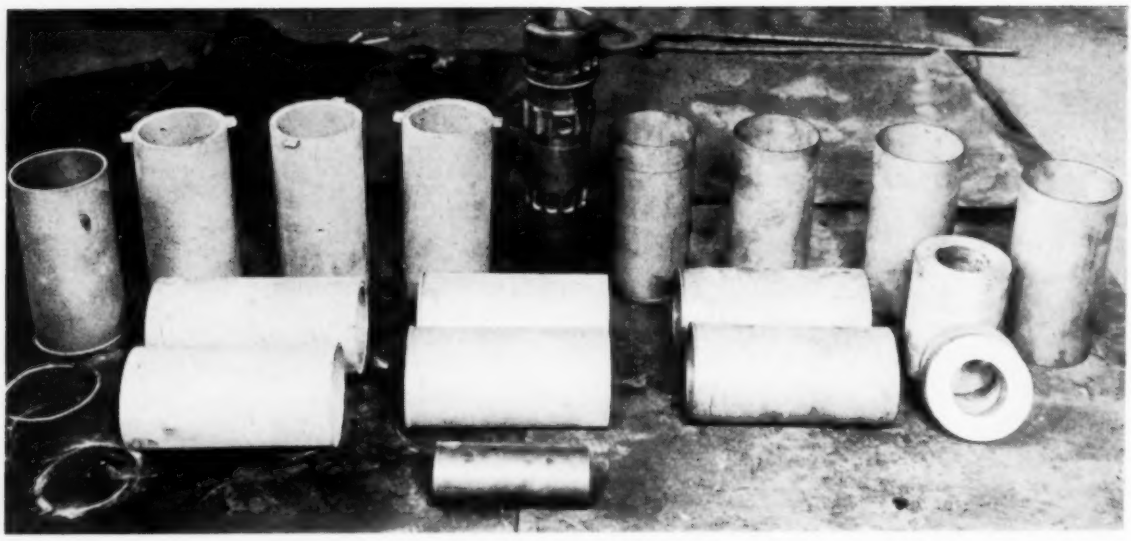


Fig. 1—A group of tubes produced by the centrifugal process. Some are in the as cast condition and others are shown finished machined

Nitriding Iron Cast Centrifugally

Cast tubes given special heat treatment to form tough case which resists wear

By ERLE F. ROSS

NITRIDED cast iron possesses a high degree of surface hardness and has the ability to retain this hardness at temperatures up to 950 degrees Fahr. Because of these properties, the material develops exceptional wear resistance and thereby is finding increasing acceptance in many fields in which wear is an important consideration. One type of casting is centrifugally cast tubes, sleeves and bushings, used principally for cylinder liners in internal combustion engines, for cylinder liners in pumps handling erosive material, for capstans of wire drawing mills, and for drill guide and spindle bushings.

Centrifugally cast nitriding iron is produced in the United States by the Forging & Casting Corp., Ferndale, Mich. The material, known as Nitricastiron, can be subjected to the surface hardening treatment of nitriding, which consists in heating the articles to be hardened in an atmosphere of ammonia in a closed box to a carefully regulated temperature for a definitely prolonged period. It is an alloyed cast iron, the composition and manufacture of which has been the subject of extensive research, culminating in a product capable of heat treatment for development of ideal metallographic structure suitable for obtaining a very hard and tough case.

The metal is a low carbon cast iron containing chromium, molybdenum and aluminum as the principal alloys. The range of analysis is rather large, and changes with the size of the castings and whether sand cast or centrifugal molded. A typical analysis range for centrifugally cast cylinder liners with approximately ⅜-inch wall is as follows: Total carbon, 2.50-2.70; chromium, 1.20-1.50; manganese, 0.50-0.60; silicon, 2.40-2.60; aluminum, 0.80-1.10; and molybdenum, 0.20-0.25 per cent.

The charge is prepared from pig iron and high-carbon steel scrap melted and refined in a 250-pound direct arc type electric furnace. Aluminum is added to the ladle and is protected from oxidation through the use of cryolite as a flux. The iron is poured at a temperature of approximately 2700 degrees Fahr. To provide complete chemical control over the raw materials as well as the quality of the finished product, a well equipped laboratory is maintained.

Tubes are made in a horizontal centrifugal casting machine which rotates at speeds ranging between 600 and 1400 revolutions per min-

ute, the speed being controlled through a slip-ring motor and a manually-operated controller. Molds consist of mild steel forgings bored to proper inside diameter to give the desired outside diameter of the tube. Wall thickness of the tube is controlled by the amount of iron poured into the mold.

The correct amount of metal is weighed into a hand ladle, then poured into the spinning mold. Freezing of the iron begins at once and is complete in less than a minute, after which the tube can be extracted from the mold immediately and the process repeated. Before the iron is poured, the inside of the mold is coated with a light layer of lampblack deposited by an oxyacetylene hand torch burning an acetylene-rich mixture. When a mold becomes too warm after repeated use, it is removed from the machine and another is substituted.

This cast iron is unsuited for use in the as-cast condition and heat treatment is required to develop the proper structure and properties. As cast, it consists of finely laminated pearlite and fine graphic flakes with considerable quantities of free carbides. The tensile strength is approximately 50,000 pounds per square inch and the brinell hardness 400 to 450. Fractures appear to range from chilled to mottled.

Heat treatment of the centrifugally cast tubes consists of heating them to 1750 degrees Fahr., holding for 1 hour, air cooling, reheating to 1475 degrees, holding for 1 hour and again air cooling. This renders the castings uniformly machinable with a brinell hardness of 280 to 320, a tensile strength of approximately 60,000 pounds per square inch, and a modulus of elasticity of about 25,000,000 pounds. The microstructure has been changed by the formation of fine particles of temper carbon in addition to the original graphite; the as-cast pearlite has coalesced into a sorbitic structure and considerable amounts of original free carbides have been absorbed so that the remaining carbides are not excessive.

As previously pointed out, the usefulness of Nitricastiron is due to its ability to develop an extremely hard case on surfaces exposed to an atmosphere of ammonia at elevated temperatures, which treatment is known as nitriding. The same process and equipment used for nitriding steels is employed for the centrifugally cast iron. In general, electric furnaces equipped with automatic temperature control are used and the parts to be nitrided are placed on racks and covered with a hood of nonnitriding metal in which the concentration and pressure of ammonia can be controlled conveniently. A temperature of 960 degrees Fahr. has been found to give satisfactory depths and quality of hardness when maintained for a period of between 50 and 60 hours. At the end of that time, the heat is lowered to below 250 degrees with the ammonia atmosphere maintained, after which the pieces can be air cooled.

In nitriding centrifugally cast cylinder liners or tubes, it generally is desirable to harden only the inside diameter and to leave the outer surface soft. This can be accomplished by several methods, one of which is to nickel plate the tubes to a thickness of 0.001-inch or slightly less, using a double salt electroplating bath with no agitation and low current to produce a dense, nonlustrous nickel deposit. After plat- *(Please turn to page 62)*

Fig. 2—A variety of centrifugally cast nitricastiron tubes, sleeves and bushings in conditions from as cast to finished machined. These can be produced in various sizes

Industry Makes Remarkable Strides

Haphazard methods in the foundry have given place to definite control systems

By ARNOLD LENZ
Chevrolet Motor Co.

ONE night recently, I sat in my library reviewing the happenings of the day and trying to chart a rough course for the next morning. Among other things, the assignment to talk before the A.F.A. came to mind. Groping for inspiration I looked down the row of *Transactions* of the A.F.A. dating back to 1912, and a row of bound volumes of THE FOUNDRY dating back to 1910.

The 1911 *Transactions* was within my reach so I picked it up and started to look through the pages. The first article by Thomas D. West was a fine combination of the practical and scholarly. I never knew him personally, but I always valued his writings.

This particular article on scrap, dealt principally with blow holes and shot in castings and is just as appropriate today as when it was written 23 years ago. I read most of it again, perhaps for the tenth time. I recommend it to anyone worried by scrap troubles.

Experts Differed on Cupolas

Other interesting articles included one on sand testing; one on permanent molds, by Custer; the efficiency movement in the foundry; mechanical charging of cupolas; and one by Dr. Moldenke covering an investigation of a method of briqueting borings by pressure only. An interesting paper by R. H. Palmer on cupola practice ended with the statement, "Each cupola seems to have an individuality of its own, and it is studying this individuality that causes success." Dr. Moldenke countered that statement by saying he never found a cupola with special peculiarities, providing all the rules of good practice were observed.

By this time I had become interested in foundry history and I started to peruse the 1910 issues of THE FOUNDRY. The convention that year was in Detroit, and in an interestng article on the automobile industry it was stated that the output for that year was estimated at 125,000 cars. This was considered truly remarkable.

In looking over the newest equipment offered at that period, I found that practically every contrivance known today was on the market in various stages of development, the majority too light for the work expected.

At that time I was still working in a jobbing foundry, and all the mechanical and metallurgical developments were known to me only through the pages of THE FOUNDRY and other magazines. My first actual contact with some of these new contrivances was at the 1913 Chicago convention. I had heard, from time to time, reports of the great things that were happening in the automobile industry in and around Detroit. Ford had built a foundry to melt 190 to 200 tons of iron per day. Other concerns were installing the latest foundry devices to help them meet the rapidly growing demand for high grade castings.

Meets the Foundry Leaders

In 1914 I visited all the leading foundries in Detroit. I met Jim Miller at Ford's; Bob Snow at the Detroit Foundry Co.; Joe Wilson and Harry Swan at Cadillac where they had just started to make cylinder blocks in dry-sand molds. I had heard Harry Swan's paper on, "High Grade Cast Iron," at the Chicago convention, and I admit that at that time it was quite over my head.

After leaving Detroit I was more than ever impressed with the opportunities and possibilities the automobile branch of the industry had to offer. There was an air of hustling and speed. Every plant was running to full capacity and was behind orders. On the surface everything was quite efficient, but a few months later when I secured a job with one of the motor companies, I was much surprised to find terrific scrap losses which easily could be traced to a general sacrificing and ignoring of the fundamentals of good foundry practice for the sake of speed. I realized for the first time how far theory and practice can be apart. It was one thing to know and have available all the latest improvements but quite another to get an organization together that could and would utilize all that advanced information. I still had to learn how difficult

it is, and how much time it takes, to build an organization that can absorb and apply in a practical way, mechanical and scientific developments without getting away from the fundamentals that are essential in the production of a high quality product at a low cost.

To manufacture at low cost does not hinge altogether on being able to buy every new thing that comes along. It is rather a co-ordinating of methods and equipment. No individual piece of equipment should be bought unless it is in harmony with what already is in use and can definitely prove its merit on the basis of quality and earning power. I found that the foundry was the bottle neck of the automobile industry. Already it had been recognized that growth had to be met with more mechanical equipment. Buick in Flint was paying as high as $16 a day for molders and core makers, and the Allyne-Ryan Foundry Co., in Cleveland was reported to be paying $25 a day, but in spite of this we were suffering from a shortage of good cylinder molders.

No Co-operation Between Departments

In those days practically no co-operation existed between the foundry and the engineering staff and very little between the foundry and pattern shop. Whatever the engineer designed the foundry was supposed to make, providing the pattern shop was able to make the pattern. Patterns and core boxes were not interchangeable. Most cores had to be filed. Good core setters learned how to file the various cores and kept this a secret. If a core setter layed off for a day, sometimes as high as 100 per cent scrap resulted. The patterns were made to 1/10-inch shrinkage, and to use different shrinkages in the same casting was not yet dreamed of. The pattern maker would prove that the pattern was according to the drawing, and if the casting did not come out that way, it was because the core was not made right or set off in the mold. There were no templets or layouts for checking.

Molding sand was bought entirely by brand, was mixed and tempered by shovel or sand cutter at night except in foundries like Ford's where sand was handled by conveyor system. There was no standard for moisture, strength or permeability, and there was no fusion test. In the morning we would pick up a handful of sand, feel it and perhaps rub it on a shovel handle, and then start to swear. Usually the sand was used because too much time would have been required to cut the heap over again.

Core sand was good but we used too much bank sand. Core oil was the bane of our existence. One day the cores would come out gummy and would not dry, a few days later we had to send everybody home because all the cores were burned. Core oil producers were seeking substitutes for linseed oil. There were no standards. The importance of heat resisting, oxidizing, gas producing, and free working qualities was not yet recognized.

Flask material had reached the stage of cast iron but everybody still was fighting against the high cost of machining the flask. Pin holes were drilled without jigs and every day some had to be set out because they were so tight on the pins that they would not draw off the plates. Flask bars were put in haphazardly, and as high as 60 gaggers and a hat full of nails were required to hold the sand in the cope. Clamping off with bottom boards was a constant nightmare because the barring of drags was still a long way off.

Old Machines Too Light

Molding machines had reached the combination stage of jolt roll-over and power draw, and some had squeezing in addition. The tendency definitely was away from squeezing into more jolting. Machines of that period were too light. On the latest jolt roll-over power draw machines we made from 40 to 60 cylinder molds per day. Each of those machines operated differently from the others. The jolts could not be regulated, and it required anywhere from 45 to 70 jolts to ram a mold. The roll-over frames holding the patterns were so weak that one side or one corner had to be held up or pushed down when drawing a pattern. The draw cylinder would start its downward journey when it was good and ready, usually at the wrong time. A good draw was an exception rather than a rule.

Cupolas were temperamental, especially on heats lasting over 3 or 4 hours. Tuyere areas were figured according to the latest theory of air requirements but seldom was allowance made for slag freezing over the tuyeres. More attention was paid to air pressure at the tuyere box than air in-put at the blower. I have seen the cupola tap hole plugged every day for months because someone insisted on using the same botting material over (*Please turn to page* 64)

Looks Back on Many Improvements in the Industry

BASED principally on his own experience as an active participant and originator of many of the improvements to which he refers, the author outlines the somewhat chaotic conditions which prevailed in the automobile casting industry 20 years ago and the remarkable manner in which the materials, methods and equipment have been developed in recent years and brought under the most absolute control. The article reflects the views of a practical foundryman whose active career as molder, coremaker, melter, foreman, superintendent and manager closely parallels the period of which he writes. The article is abstracted from a paper presented by Arnold Lenz at the international convention of the American Foundrymen's association, Philadelphia, Oct. 22-26. Mr. Lenz is assistant manager of manufacturing, Chevrolet Motor Co., and the recipient this year of the J. H. Whiting gold medal of the American Foundrymen's association for conspicuous service to the advancement of the foundry industry.

Simplify Molding of Steam Chest

Cost reduced by installation of molding machine, special pattern and steel flask

By H. W. KELLY

FOR a period of about 20 years the casting shown in Fig. 2 was molded by hand. Three molders and three helpers produced one casting in a 9-hour day. In service, the casting is filled with live steam to maintain the temperature necessary for mangling large sheets, quilts and other items in a laundry. In many instances after the castings were cleaned they were found to be scabbed, crooked or spongy, totally unfitted for use.

The surface had to be absolutely smooth, flat and free from surface imperfections. The outside face was machined and then ground to a glass smooth surface. This perfection was extremely difficult to attain when the casting was made in a large, clumsy wood flask, about 4 feet in height. The bottom board was heavy and awkward, the clamps were clumsy and ill fitting. Tapping iron wedges on top of the chaplets often caused sand to fall in the mold and thus destroy the clean face of the casting. The cope for each mold was dried for 2 to 3 hours over a charcoal fire, but even this precaution did not always insure a clean surface. Three large risers were placed in the center of the flat surface. In many instances the metal in the vicinity of the risers was spongy instead of being solid.

When complete the casting was approximately 110 inches in length, 24 inches wide, 8 inches in height at the narrow side and about 10 inches at the widest side. Estimated weight of the casting was 2000 pounds, but it was found practically impossible to hold the weight to this limit. As a result the foundry suffered considerable loss through overweight castings. The selling price was about $125.00.

As a result of the customer insisting on greater production and better quality the management gave the writer authority to take any steps necessary in the production of perfect castings. This involved serious thinking and a great deal of figuring and planning on the best and most economical method to adopt. We finally decided to invest in new pattern and flask equipment and to make the molds on a machine.

A great deal of work was necessary in laying of concrete foundations, building flasks and other equipment. Installation of the machine was left to the manufacturer. Our attention was

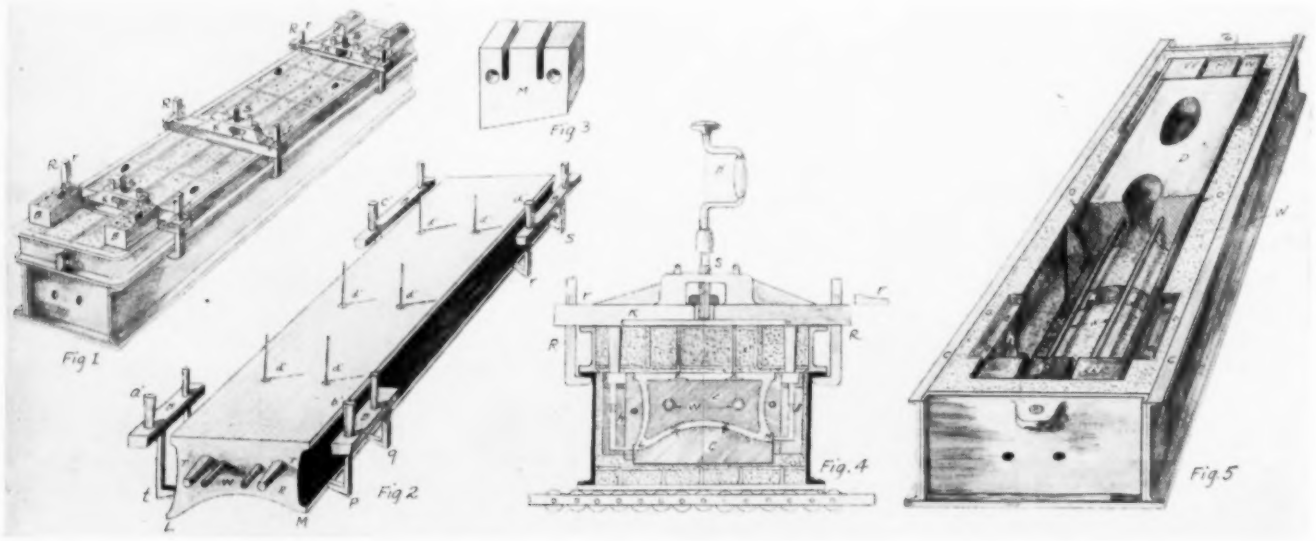


Fig. 1—Completed mold with runner basins, chaplet bars and clamps in place. Fig. 2—The casting showing gates, vents and chaplets. Fig. 3—One of the end cores. Fig. 4—Sectional view of assembled mold showing method of anchoring main core. Fig. 5—Drag mold showing end, side and center cores

concentrated on the design of the flasks and auxiliary equipment.

The pattern was mounted on a flat board with proper core prints in place. Lugs on the board facilitated rapid attachment and detachment on the machine in the slots *HH* Fig. 6. The required number of drag molds were made and placed on the floor before the copes were made on the same machine. A considerable amount of work was involved in placing all the cores in the drags before the copes were lowered into place.

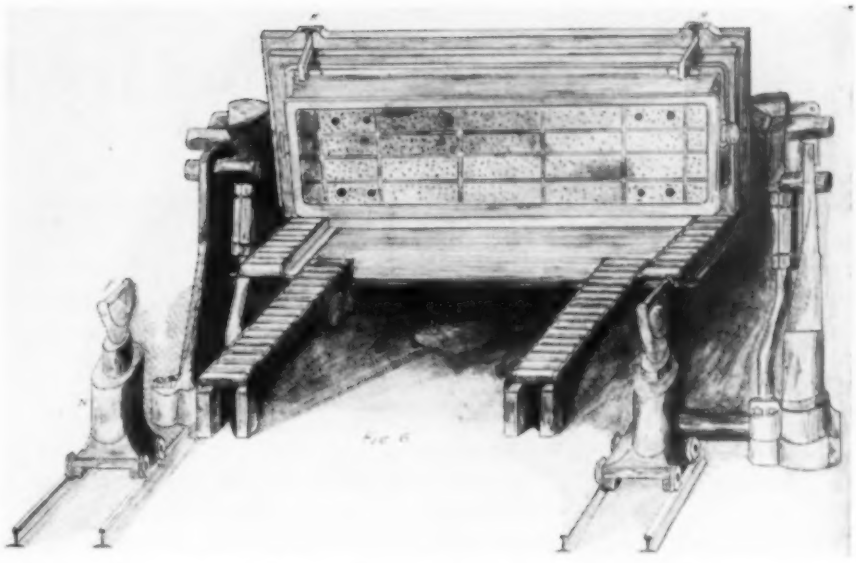


Fig. 6—Both cope and drag are rammed on the same jolt, rollover molding machine. The cope later is rolled back to its original position on the device shown right and left in the foreground

The pattern board, 4 inches thick of clear white pine, was equipped with cast iron bumper pads which projected 1/16-inch on the face side. The flask rested on these pads and protected the board from the jolting effect. They also maintained the flask in the correct position. The drag flask is made up of extra heavy 15-inch channels, 13 feet in length, with cast iron ends 30 inches wide bolted to the channels. This forms a drag 30 inches wide, 12 feet 2 inches in length on the inside and 15 inches deep. The bars are cast iron grids, bolted with countersunk head bolts to one side of the drag and extending to within 2 inches of the pattern. The flask is located by pins at each end of the pattern board.

Large Number of Cores Required

Nineteen cores required in the production of the casting are all placed in the drag half of the mold. Two of these cores shown at *C* Figs. 4 and 5 are rammed up in the mold and support chaplets *KK* Fig. 5 under the heavy dry sand core *D*.

In molding the drag the cores *C C* are placed in position on the curved side of the pattern. The drag then is placed in position on the pattern board where a rich sea coal facing is riddled over the surface of the pattern. The drag then is filled with sand, jolted several times, butted off with an air rammer, struck off and rolled over. The machine draws the pattern, after which the drag is lifted and set down on a level sand bed on the floor. The machine operators repeat the cycle of operations on the next drag mold, while the core setters work on the drag on the floor. All green sand surfaces to be exposed to the metal are covered with a coating of plumbago. The two side cores, each in two sections for easy handling are placed first. These cores form the concave sides of the casting as shown at *T T* Fig. 2. The end cores *M* and *N* then are placed in position. These cores form the ends of the casting as shown at *W* Fig. 5. They govern the position and also act as part support to the large, heavy core *D*. They also are provided with prints for the reception of the vent pipes *W* Fig. 5. These pipes are freely perforated with ¼-inch holes and are connected with wax vents in the cores and extend to suitable openings in the end of the flask.

After the main core *D* is placed in position, the gate cores are lowered into place alongside the side cores *O* and *O*. The openings in these gate cores coincide with flat gates ¼ x 1-inch in the side cores *O* and *O*. Metal enters the mold at the bottom as shown at *L* and *M* Fig. 4. Basin cores *abcd* Fig. 5 are placed over the gate cores. A jet of air is blown through sprues and gates to remove any loose particles of sand or dust. With all the cores in place the slots over the vent pipes in the end cores are packed with sand and clay and the drag then is ready to receive the cope.

The pattern for the cope is a flat board with the exception of the slight projections or buttons for locating the chaplets *d* and *d* Fig. 4, also the riser sticks and sprues. The cope flask is a one-piece casting, same length and width as the drag, but only 7 inches deep. Grid construction bars in the cope extend to within ½-inch of the pattern.

The cope is made on the machine practically in the same manner as the drag. Seacoal facing is riddled over the surface of the pattern. Then the flask is filled, jolted and butt rammed. The cope is rolled over onto the receivers *N* and *M*, Fig. 6. Moved away from the machine on rollers to a point where it again may be rolled back to its original position on the cope trunnions which coincide with the shaft of the receivers at *F F* Fig. 6. Before it is rolled back the surface is blacked and the chaplets are inserted at the points indicated by the buttons. The cope then is inverted and poised above the drag. The air is released in the receivers *N* and *M* and the cope sinks into place on the (*Please turn to page* 68)

Use Plaster For Foundry Patterns

Double match expedites production—Life of patterns increased by electroplating

QUANTITY production of duplicate castings owes its success in large measure to the use of the metal matchplate. Ever since matchplates became a regular part of foundry esuipment—from the primitive sand match or wood followboard to the highly finished non-shrinking white metal plate—every change has been synonymous with ever increasing production. Initial cost of high grade plates is so great that large production is necessary to absorb it. Many foundries for one reason or another are unable to avail themselves of the benefit of this method of mounting patterns.

The plaster match has been in use for many years. However, in its general application it should more properly be referred to as a followboard. After the drag part of the mold is rolled over, the function of the followboard ceases. It supports the pattern in the proper position for ramming and forms the parting surface for the cope, but the cope has to be rammed directly on the drag and therefore half the benefit of the match is lost.

Plaster Matches for Cope and Drag

The double plaster match shown in Fig. 29 presents several interesting features not only on account of the simplicity and economy, but more particularly because it furnishes a hard, firm surface on which to ram both the cope and the drag. It is made in two parts, one for the cope and one for the drag. Another advantage of this arrangement is that cope and drag may be placed side by side on a bench or machine and rammed simultaneously. To increase production, two men can work on the same job, one making copes and one making drags without the friction sometimes incident to two men working together. This type of match will pay for itself on orders for 50 castings, and in some instances on considerably smaller numbers.

It may be used on the bench or floor or on a molding machine. Durability of this type of match is attested by the statement that 300 or more molds have been made off some of them and that they still are in good shape. With reasonable care they should last indefinitely. However, this feature usually is of no particular interest. Having served their purpose and with no other order immediately in sight, it might be just as well to knock out the plaster and use the frames for another pattern. If it seems expedient to save the match for future use and if the frames are needed in the meantime, a few with pronounced taper on the inside may be fitted up. When the order is finished the bolts or screws are removed from the bottom board. The plaster is placed in the pattern storage and the frames are refilled.

Initial cost of one of these matches is approximately $4 for patternmaking, molding and fitting. The cost of course will vary for large and small frames. Usually the increase in one day's production will offset the cost.

No Great Skill Is Required

In using these matches the molder treats both as if they were drags. With the aid of a vibrator or other slight rapping a good, clean draw is assured in both cases. If the face of the mold is disturbed to any small extent in removing the match, the sand easily is pressed back into place.

No great degree of skill is required in making the match. A mold is made in the usual manner as shown at *A* except that it may be advisable to ram the sand a little harder than usual. The parting is made carefully and accurately and after the cope has been rammed it is removed and laid on its back at *B*. A shallow frame *C* provided with suitable pin guides is placed on the cope and filled with plaster as shown at *D*. When the plaster has set a bottom board is nailed or screwed to the frame. The cope match then is removed and turned over as shown at *E* where it is ready for use.

Successive steps in the production of the drag match are shown at the right in the Fig. 29. The green sand mold with pattern in place is shown at *A*. At *F* the cope has been removed. A gate passage is cut in the joint, but the pattern is not removed. The frame *K* is placed in position and filled with plaster and provision is made for anchoring the pattern either by screws to blocks of wood bedded in the plaster as at *L* or by a bolt or bolts through the bottom board as shown at *M*. In some instances it may be advisable to

reinforce the plaster by rods, pieces of pipe or wires.

After the plaster has set the match is lifted off and placed upon its back as shown at *H*. The screws or bolts are inserted to anchor the pattern firmly in place and then the drag part of the match is ready for use.

In preparing the plaster the best results are secured by mixing it by hand in a pail until it just begins to set. Place the frames in place, one on the cope and the other on the drag. Spray oil all over the joint and exposed surface of the pattern before pouring the plaster. If it is sluggish, spread it along by hand. The less water used the better. It will dry more quickly and will not shrink or crack.

Have Higher Strength

In recent years several proprietary materials have been developed and have found wide acceptance in the field formerly occupied solely by plaster. They are manipulated in the same manner as plaster, but they become harder and develop much higher tensile strength upon solidification. Under certain conditions, for example where a considerable amount of hand carving or tooling is required, plaster finds favor.

Probably in the majority of instances plaster is a more satisfactory material than wood for making small chill patterns, particularly where the chills are to fit against an uneven contour. A small frame is placed around the area on the pattern to be occupied by the chill and the frame then is filled with liquid plaster. Later the block of hard plaster is removed and—if necessary—pared to the required thickness. A sand mold then is made from the plaster block and filled metal to form the chill.

A somewhat similar condition prevails in some instances where a patch casting or any other casting has to be fitted against an irregular surface. All the hand fitting, chalking and carving incident to the production of a wood pattern for this purpose, is eliminated by the use of plaster. A plaster cast is made on the surface and then this cast will serve as a pattern for the required casting.

Occasionally the necessity arises of increasing the thickness of a sheave wheel or other circular pattern. Fig. 30 shows a typical method of increasing the thickness of the pattern by sweeping a layer of plaster over the surface. In instances of this kind, of course the object is to have the plaster adhere to the pattern, therefore the surface of the existing pattern is not oiled. The sweep *N* is provided with a dowel pin near one end which fits into a corresponding small opening in the top of the hub. The outer end of the sweep rides on the core print. If no print is present, the sweep rides on a small block attached to the lower edge at any convenient point. The small furrow left by this block is filled with plaster after the sweep is removed.

Usually a plaster pattern only is used in an emergency and where only a small number of castings are required. Occasionally an arbitrary time limit involves the production of a considerable quantity of castings before a proper wood or metal pattern can be prepared. The main objection to a plaster pattern is that it is too fragile to withstand rough usage. The corners and sharp edges soon become chipped and the pattern easily is broken under the rammer. We are indebted to W. F. Luthmann for the following description of a method of coating plaster patterns with a thin metal skin which converts them for all practical purposes into metal patterns.

After the plaster pattern is finished it is dipped into a bath of slow boiling wax until it has soaked up a sufficient quantity to render the surface impervious to moisture. Then it is painted with a metallic substance in the form of unlacquered bronze to serve as a conductor of the electric current. It is advisable to apply two or more coatings of unlacquered bronze to insure a perfect metallic contact over the entire surface of the treated (*Please turn to page* 74)

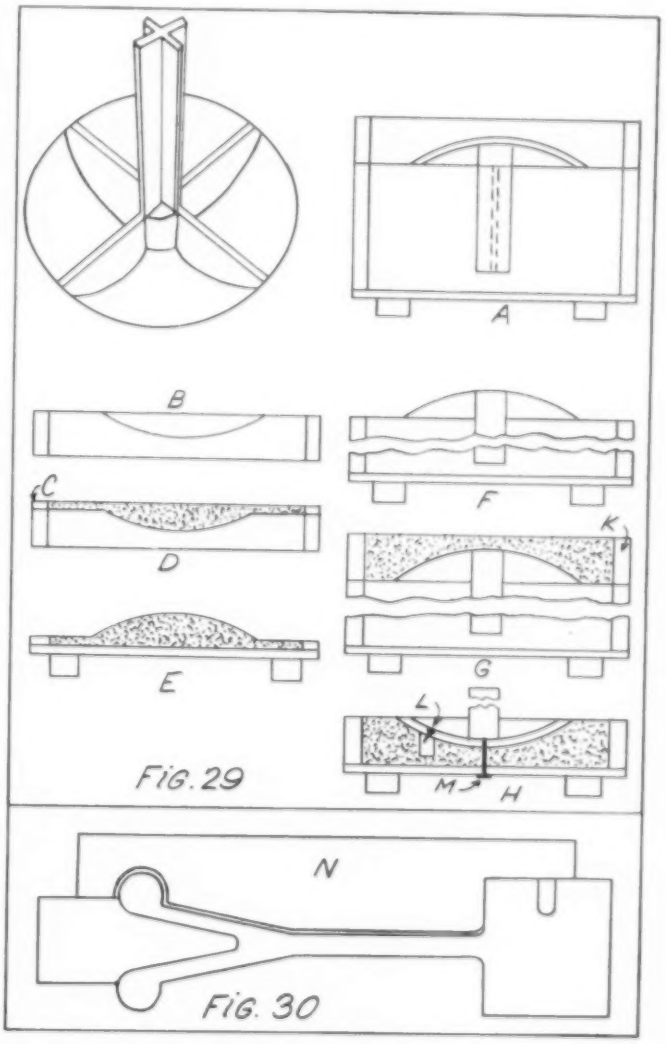


Fig. 29 (Above)—Successive steps in the development of a composition or plaster follow board. Fig. 30 (Below)—A sweep is employed to spread a thickness of plaster on an existing pattern

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Smooth Surface on Steel Castings Depends on Facing Sand

We are making high chromium steel castings containing 25 to 30 per cent chromium; 0.20 per cent carbon; 0.50 per cent manganese and 0.50 per cent silicon, and high chromium-nickel steel castings containing 18 per cent chromium; 8 per cent nickel and 0.10 to 0.12 per cent carbon. The surfaces of the castings are not smooth, but are pock marked or pock pitted. Depth of pocks is approximately $\frac{1}{16}$-inch, and cover considerable area in the neighborhood of the gates and generally more pronounced on cored surfaces. The steels are made in a basic electric furnace, and are poured hot. Metal under the pock marks is solid, and has the appearance of thoroughly killed steel. Molds are baked or dried thoroughly.

Obtaining a smooth surface on steel castings, whether plain carbon or alloy type steels, is the result of careful attention to the sand used for facing. The facing must be composed of grains uniform in size, extremely refractory, and as free as possible from fine, inert material which lowers the permeability. Consequently, considerable new sand is used in making facing sands, and the ratio of new sand to old sand varies considerably from shop to shop. Sometimes all new sand is used, but the average probably is 3 parts of old sand to one of new sand. In view of the trouble you are encountering, it may be advisable to try all new sand facing. Numerous mixtures may be used, one suggestion being 24 quarts of new sand, 2 quarts of silica flour, and 1 quart of bentonite. Temper with molasses water 1 to 50.

From your description, it appears that the trouble results from particles of sand being washed or scoured from the sprue, gates, mold face or core surfaces. Use of a good facing sand, and careful attention to application of the silica wash, which should not contain any more clay than absolutely necessary, nor be applied too thick, will correct washing on the mold face, gates, etc. It also may be advisable to coat the cores with silica wash to increase their refractoriness, and to obtain a smoother surface.

Bronze Mold Is Used For Making Slush Castings

Have you any books or other literature dealing with the production of slush mold castings. We will appreciate information on the metal mixtures for both molds and castings, how the molds are made and operated and any other pertinent information.

So far as we know no book has been published dealing exclusively with the production of castings by the slush mold method. Brief and scattered references have appeared in books dealing with the die casting of metals. On several occasions the essential features of the process have been covered in the question and answer department of THE FOUNDRY.

The castings are made from a white metal mixture poured in a permanent metal mold. The mold usually is bronze and may vary to a considerable extent in composition without effecting its utility. The white metal mixture for the castings also may vary through a wide range, but in the majority of instances it is an antimonial lead carrying from 14 to 18 per cent antimony.

Initial expense of making the molds—in many instances—is quite heavy and only is justified in the subsequent long life and enormous producing capacity. One mold will serve for thousands of castings and in that manner the initial expense is absorbed and the expense per casting is comparatively light. A bronze mold in several parts is made from an original plaster cast. The number of parts will depend on the shape of the proposed casting involving one or more parting lines. In many cases the parts are what usually are referred to as drawbacks. The parts are finished carefully and accurately machined on the joints to fit closely together. They are assembled on a base or otherwise and arranged in such a manner that a pull from one or more levers will alternately bring them all together in

their proper relative positions to receive the metal, or, separate them a sufficient distance from each other so that the casting may be removed.

Metal for slush castings is melted in an iron pot and dipped out wit ha small ladle. Two men usually work together. One handles the ladle and the other manipulates the mold. A considerable degree of skill and judgment is required on the part of the operator to determine the cooling speed of the metal. The finished casting is in the shape of a shell. The temperature of the metal and time it is allowed to remain in the mold determine the thickness of this shell. Each casting must conform to a uniform and definite weight. All castings above or below this weight are rejected.

In operation the mold is filled with metal. When the operator decides that the metal has solidified to a sufficient thickness, the mold is turned over and the liquid metal in the center is spilled back into the ladle and then returned to the melting pot. Usually two pots are employed. One contains metal of the proper temperature, the other receives the return metal and gradually brings it up to the desired temperature. The pots are worked alternately. Usually the elapsed time while the metal is in the mold is reckoned in seconds. Therefore it is apparent that the judgment of the operator is the most important factor in the cycle.

Aluminum Borings Should be Melted in Bath of Metal

What is the best method of melting aluminum borings and turnings. We melt in crucibles using an oil furnace, but seem to have too much loss by slag which of course, makes costly metal.

Melting aluminum borings and turnings is at best a long, tedious operation, often beset by difficulties which sometimes make the resulting metal more costly than if it were purchased in ingot form from a reputable secondary smelter. That is particularly true when the borings and turnings are dirty and oily. We believe that if you make a careful survey of all costs entering into reclamation of borings and turnings, you will find that it will be cheaper to purchase your metal in ingot form.

However, if you are of the opinion that it is a paying proposition to recover the borings and turnings, the proper procedure is first to form a small heel of molten metal in the bottom of the crucible. That heel preferably should be formed from an ingot or from heavy scrap. Let the heel reach a temperature of say 1400 to 1500 degrees Fahr., and then add a definite amount of the borings and turnings. The amount added should not be enough to chill the mass, but just sufficient to be absorbed readily by the molten metal. Then allow the metal to come up to temperature again, and repeat the cycle until the crucible is full of molten metal. For a flux to clean the metal use a small amount of cryolite or zinc chloride.

Paste Protects Core From Cutting Action of Metal

From time to time we have trouble in making bronze bushings, using a mixture of 80 per cent copper; 10 per cent tin and 10 per cent lead. The metal is poured at 1900 degrees Fahr. The metal seems to cut the core. We are making these cores from lake sand, or sharp sand as some call it, and linseed oil. We bake these cores thoroughly and give them two coats of graphite mixed with molasses water. Have you any suggestions as to how we can eliminate this cutting?

To prevent a leaded bronze from attacking the surface of cores, a common practice that has proved effective is to rub the surface of the cores with a mixture of graphite and mineral oil. Of course, the oil should be used as sparingly as possible—just enough to make a paste of the graphite, because the oil burns when the metal strikes it, however, that causes no trouble if the oil is not used too freely.

Rub the paste on the core by hand or with a tool, sufficient to close up the pores and form a

The Foundry to Publish Bolton's Book on Gray Cast Iron

JOHN W. BOLTON, metallurgist, The Lunkenheimer Co., Cincinnati, and a member of the editorial advisory staff of THE FOUNDRY, has just completed a book on "Gray Cast Iron", which presents in detail all of the latest developments in raw materials, practices, metallurgy and engineering properties of gray iron castings.

THE FOUNDRY is pleased to announce that a large portion of this most valuable contribution to the literature of the gray iron foundry industry will be presented serially in its editorial pages, starting with the April issue. Later the complete and extended work will be published in book form by the Penton Publishing Co.

Recognized as one of the outstanding metallurgists of the foundry industry, Mr. Bolton is ideally fitted from the standpoint of technical training, foundry experience and leadership in research to prepare such a practical and at the same time scientific study of the subject of gray iron. Past contributions to THE FOUNDRY and his excellent papers presented before the American Foundrymen's association, the American Society for Testing Materials and other technical groups provide ample proof of his ability as a writer on foundry subjects. Undoubtedly this newest work will fill a long felt need for a complete discussion in one volume of the subject of gray cast iron.

First installments will concern the effect of various alloys, including carbon, silicon, manganese, sulphur, phosphorus, nickel, chromium, molybdenum, copper, aluminum, titanium, cerium, zirconium and the various other elements, on the structural, engineering and physical properties of gray cast iron. Unquestionably, this particular part of the book, which is presented under the title of structural metallurgy, will be accepted as the standard reference on that subject by the foundry industry. Watch for the first installment in THE FOUNDRY for April.

complete, smooth, impervious coating.

Others use a paste made with linseed oil, which of course makes a material that finally becomes hard and consequently brittle. This is easily damaged in handling the core, but if it is not damaged, it makes a very protective coating. In both cases the oil should be used as sparingly as possible.

Needs Proper Base Mixture for Alloying

We manufacture oil burners and make the cast iron rings ¼-inch thick that go on top of the burner. We are having trouble with growth. Can you suggest any additions to our small 50-pound ladles of metal to eliminate the trouble?

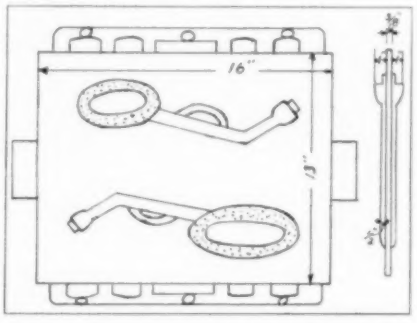
The trouble is due to an improper base mixture. Hence, the remedy lies in eliminating the root of the trouble rather than trying to cure it by doctoring the metal. Evidently, certain factors not mentioned militate against changing your iron charges to obtain the proper mixture. However, a simple addition of an alloy to the molten metal is not a cure-all as to obtain the highest benefit from an alloy it is necessary to have the right base mixture. Also difficulties will be encountered in the small amount of metal to be treated due to the cooling effect of alloy additions.

The only suggestion that we can make is to try the addition of from 5 to 6 ounces of 70 per cent ferrochromium. The ferrochromium should be finely ground say 12 or 20 mesh and should be heated red hot on a shovel or some other means before adding to the 50-pound ladle which of course should contain white hot metal. Alloy additions will give from 0.4 to 0.5 per cent chromium in the iron. If that is not sufficient to prevent the growth, more chromium will have to be added.

Aluminum Plate Shows Shrinkage on Top

We are having trouble with shrinkage on an aluminum matchplate for a gas-burner. The plate is gated along both sides with a riser at each end of the runner. The gates are cut the full thickness of the plate and are fed from a deep runner in both cope and drag. The metal mixture, half scrap and half new metal, is poured at a moderate temperature. We shall appreciate any advice on how to secure a smooth, unshrunken cope surface.

The heavy gates and runners at the sides of the plate shown in the accompanying illustration are of no particular benefit on this wide, thin, flat casting. The thin metal freezes in the plate before it freezes in the heavier sections representing the gas burner parts. Thus while the metal in the gates and runners is still liquid and available for feeding, it cannot reach the heavy sections of the pattern plate while these parts are solidifying and shrinking, later. The present style of gate answers the purpose admirably so far as securing a clean casting is concerned, but it might be improved to some extent by confining the runner to the cope.



The casting is poured from both sides simultaneously through sprues erected over the center of the long runners runners

Two methods are available for overcoming shrinkage on the parts projecting above the plate. One is to place metal inserts in the mold. The second is to place feeding risers on the high points. The inserts, in this instance straight or spiral pieces of aluminum wire, are stuck in the sand so that the ends project into the mold where the shrinkage is anticipated, or where it has developed in a former trial. In extreme instances a fairly junky piece of aluminum is held in place in the mold by suitable chaplets. The object is to cool the metal in the vicinity rapidly and thus, to some extent, equalize the cooling and shrinking speed between the thick and thin parts of the casting. If for any reason you are prevented from using inserts, a 2-inch riser, reduced to 1-inch at the junction and at least 4 inches in height at each end of the gas burner part, will insure solid castings.

Defects in Liner Usually Due to the Core

The machine shop reports finding sand in the initial casting on an order for several bronze liners 10-inch diameter, 8-inch core and 6 feet in length. The mold was made in No. 2 Albany sand in a wood flask and skin dried and then turned up on end for pouring. The metal entered the mold through three pop gates ⅜ x 1 inch. A fourth gate opening served as a riser. Since the metal ate into the sand in the first casting, we decided to pour the second casting through two gates. We shall appreciate your opinion on this point.

To the average machinist, all cavities in a casting are sand holes, irrespective of whether they are empty, smooth and shiny, or, filled with sand. In the present instance, a casting weighing close to 600 pounds, three gates of the dimensions shown are not excessive. In fact the fourth opening also might be pressed into service as a gate instead of a riser. No riser is needed on this casting. The man pouring the metal readily can determine when to stop by noting the level of the metal in the pouring basin.

The casting may be made in a wood flask properly barred and securely clamped, but it will be heavier than a similar casting made in dry sand in an iron flask. Also attention is directed to the fact that a slight yielding of the mold in the bottom area will cause the metal to settle downward from the top and thus create the impression that a feeding head is necessary.

We assume of course that the pattern is from 4 to 6 inches longer than the required casting to take care of shrinkage, contraction and dross that may float up. The defect reported by the machine shop may be due to either one of two principal causes, or, it may be due to a combination of both. If a roughing cut over the surface shows clean metal everywhere with the exception of one or two comparatively small areas where the tool cuts through a mixture of metal and sand, then it is apparent that a certain amount of dross floating on top of the rising metal was caught and held against the wall of the mold. This dross or foreign material may be sand washed from the runner basin, from the gates, or from the walls of the mold or core. A careful check on all these features will determine that point.

The second principal cause, and by far the more prevalent of the two, is a core which causes the metal in the vicinity to boil as it rises alongside. This violent action displaces sand and blacking from the surface and this foreign material is caught at various points against the face of the mold in its ascent. In this form of defect blowholes always are present in the casting in addition to the sandy deposits. In the first instance where only a small amount of dross is present a rapid shower of hot metal from pop gates set closely around the top, will break up the dross, or at least keep it in motion until it reaches the top. In the second instance the only remedy is to provide an abnormally porous core from which the vent can escape with the greatest rapidity.

Viewing Foundry Developments

At Short Range

A FOUNDRY producing heat resisting castings subjected to intermittent temperatures ranging to 1800 degrees Fahr. uses a mixture of 50 per cent straight bessemer pig iron, 30 per cent steel rails and 20 per cent silvery mayari pig iron of from 10.40 to 10.50 per cent silicon. Ferrochrome carrying 70 per cent chromium is added at the spout in the amount of 14 ounces per 100 pounds of metal. The resulting analysis is as follows: Silicon 2.2 per cent; manganese 0.8 per cent; phosphorus 0.08 per cent; sulphur 0.06 per cent, chrome 1.00 per cent; nickel 0.02 per cent. The castings are normalized at 1000 degrees Fahr. and are said to give better than 800 hours continuous service.

♦ ♦ ♦

In steels containing 0.05 to 0.30 per cent carbon, and from 0.08 to 0.17 per cent phosphorus, brittleness resulting from phosphorus can be overcome by the addition of from 0.5 to 1 per cent chromium according to a recent patent.

♦ ♦ ♦

Due to use of aluminum in nitriding cast irons, some difficulty is encountered from the oxide skin formed, and it is claimed that use of cryolite for a flux on the molten metal eliminates such trouble.

♦ ♦ ♦

NORMAL peripheral speed of tumbling mills is 200 feet per minute. When cleaning stove plate, the peripheral speed is reduced to around 175 feet per minute, while with small chunky work, a peripheral speed of 250 feet per minute may be used.

♦ ♦ ♦

Cast iron of the following analysis is being used by a large machine tool manufacturer in castings having considerable variation in section size: Total carbon, 2.75 to 3.00 per cent; silicon, 1.50 to 2.00 per cent; sulphur and phosphorus, 0.10 per cent maximum; manganese, 0.70 to 1.00 per cent; nickel, 1.30 to 1.75 per cent; chromium, 0.30 to 0.50 per cent. Seventy per cent of steel was used in the mixture. This iron has a tensile strength, heat treated of 65,000 to 75,000 pounds per square inch; tensile strength, as cast, 50,000 to 55,000 pounds per square inch; a transverse strength as cast of 5000 to 5500 pounds per square inch; a brinell hardness of 212 to 240 in the as cast state and a brinell hardness, heat treated, of 286 to 340.

♦ ♦ ♦

IMPROVEMENT in casting technique has permitted the Ford Motor Co. to decrease the thickness of the cylinder walls and other sections of the cylinder block and crankcase castings in its V-8 engine by amounts in some instances up to 1/16-inch.

♦ ♦ ♦

While the use of chromium in malleable cast iron causes trouble in graphitization, a recent patent states that such trouble can be eliminated by increasing the silicon content, preferably in the ratio from 0.2 to 0.7 to the chromium content. It cites addition of 0.15 to 2 per cent chromium and from 0.3 to 2.0 per cent silicon.

♦ ♦ ♦

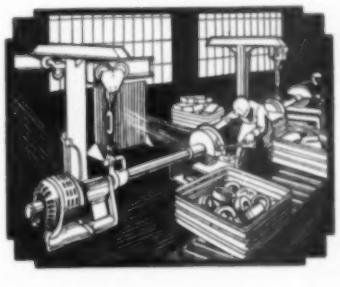
Guides and carriers for a wire drawing plant are produced from an alloy cast iron with the following composition and properties: Total carbon, 3.10 to 3.30 per cent; silicon, 1.30 to 1.40 per cent; nickel, 2.25 to 2.75 per cent; chromium 0.40 to 0.60 per cent; brinell hardness after oil quench from 1550 degrees Fahr., 550. Fifty per cent of steel was used in the charge.

♦ ♦ ♦

After oil quenching and drawing at 900 to 1100 degrees Fahr., Meehanite is said to give the following properties: Brinell, 270 to 350; elastic limit, over 50,000 pounds per square inch; tensile strength, over 70,000 pounds per square inch; charpy impact, over 11 foot pounds; machinability, 35 to 40 inches per minute using ordinary high speed steel cutting tools.

♦ ♦ ♦

DISSIPATION of heat during the braking action on the modern high-powered automobiles is quite a problem, and to some extent has been overcome by using large surface area drums, ribbing the exteriors, etc. However, one of the newest ideas is application of a metal with high thermal conductivity to the exterior drum surface. On one type of patented drum, that is accomplished through the use of centrifugal casting and an alloy iron containing not less than 3 nor more than 15 per cent copper. The drums are cast in dry sand molds on a vertical spindle machine rotating at 5000 surface feet per minute at a temperature ranging from 2300 to 3000 degrees Fahr. Action of the centrifugal force throws most of the copper to the outside so that the drum has a copper rim, and it is said that there is no



sharp line of demarcation between the copper rim, and the alloy iron interior.

Steel guide shoes serving a seamless tube mill in this country and containing nickel and chromium, lasted for a rolling campaign of about five hours or 580 passes. Recently these guides were replaced with shoes containing chromium and molybdenum and in excess of 10,000 passes now are being obtained at a decided saving in cost because of the elimination of shutdowns.

The FOUNDRY Family Photograph Album

Upper Left

E. H. DIX JR.

Aluminum Co. of America
New Kensington, Pa.

Upper Right

J. H. JOHNSTON

Westinghouse Electric & Mfg. Co.
Trafford City, Pa.

Lower Left

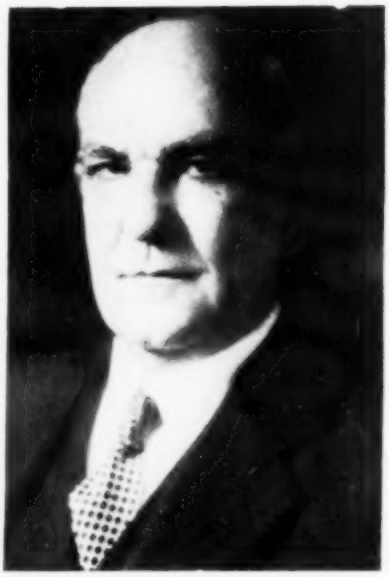
E. L. MCNAMARA

United Engineering & Foundry Co.
Pittsburgh

Lower Right

DR. H. A. BUEHLER

American Institute of Mining & Metallurgical Engineers



Men of Industry

Whose Activities Are Making Foundry History

CHARLES L. BERGER, president, Eastern Malleable Iron Co., Naugatuck, Conn., has been elected chairman of the board. LEWIS A. DIBBLE, president, Risdon Mfg. Co., Naugatuck, has been elected president of the Eastern Malleable Iron Co.; EMIL MANNWEILER, JOHN E. WALKER, and GEORGE E. BEAN have been named vice presidents; GEORGE B. WOOLSON,

Charles L. Berger

secretary and treasurer; and CHARLES E. BRUST, assistant treasurer.

Mr. Berger had been president of the Eastern Malleable Iron Co. since 1924 and associated with that organization for 48 years. He was born in Branford, Conn., Nov. 9, 1870, and was graduated from Branford high school and New Haven business college and then became associated with the office of the Naugatuck Malleable Iron Co., one of the predecessors of the Eastern Malleable Iron Co. Advancing through several positions, he was made president in 1924.

FRANKLIN FARREL JR., recently was re-elected chairman of the board, Farrel-Birmingham Co., Ansonia, Conn.

NELSON W. PICKERING was re-elected vice president; CARL HITCHCOCK, FRANKLIN R. HOADLEY and ARMIN G. KESSLER, vice presidents; FREDERICK M. DREW JR., treasurer; LAURIE K. BLACKMAN, assistant treasurer; GEORGE C. BRYANT, secretary, and WILLIAM B. MARVIN, assistant secretary.

GEORGE F. ELLIOTT has been elected president of the Elliott Co., Jeannette, Pa., succeeding his father, the late W. S. Elliott.

JAMES S. WATSON, plant manager of the Link-Belt Co., Indianapolis, has been re-elected second vice president of the Associated Employers of Indianapolis by the board of directors.

DAVID P. WILLIAMS, vice president of Vulcan Mold & Iron Co., Latrobe, Pa., has been elected a director of the company and will devote most of his time to sales work.

R. W. MCCANDLISH, formerly vice president and sales manager, Standard Silica Co., Chicago, has become associated with the Research Corp., New York, at its Chicago office, 59 East Van Buren street.

DR. H. A. BUEHLER (See Foundry Album on page 38), newly elected president of the American Institute of Mining and Metallurgical engineers, is state geologist and director of the Missouri bureau of geology and mines, Rolla, Mo. Dr. Buehler was graduated from the University of Wisconsin, and for 6 years served as assistant state geologist of Missouri. For the next 2 years he was geologist for the Federal Lead Co. He then was recalled by the state of Missouri to serve as state geologist and director of its bureau, and has held both positions ever since.

Dr. Buehler has been the recipient of many honors, including a doctor of science degree from the University of Missouri. He was elected to life membership in the American Institute of Mining and Metallurgical Engineers over a decade ago.

ARTHUR J. TUSCANY, for the past 7 years executive secretary of the Gray Iron Founders' society and its predecessor, the Gray Iron institute, has

Arthur J. Tuscany

resigned to establish headquarters at 1213 West Third street, Cleveland, to provide active and advisory service to trade associations and code authorities. As previously announced in THE FOUNDRY, Mr. Tuscany was elected executive secretary of the Foundry Equipment Manufacturers' association and of the code authority of the foundry equipment industry recently.

Mr. Tuscany was born in Cleveland and received his education from schools of that city. Early in his career he was associated with Johns-Manville Inc. in various capacities, particularly in sales work. During the next 3 years he was director and sales manager and later treasurer of the Whitney Tractor Co., Cleveland. In 1922 he was made secretary-manager of Ohio Foundries association and in 1928 he assumed the position of manager of the newly formed Gray Iron institute. In that capacity he directed a broad program of service to the gray iron

industry. With the advent of national legislation establishing codes of fair competition, Mr. Tuscany took an aggressive part in organizing the gray iron industry for negotiations in securing the code of fair competition. Since that time he has handled administrative matters for the national code authority as well as continuing the direction of trade association activities for the industry.

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HENRY D. MILES, president, Buffalo Foundry & Machine Co., Buffalo, has been appointed industry's representative on the second panel of the New York state NRA adjustment board, with headquarters in Buffalo.

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J. I. BAKER has been elected president and general manager, Safety Grinding Wheel & Machine Co., Springfield, O. GEORGE E. VANCE has been elected vice president and treasurer of the company and H. G. WINLAND has been named secretary.

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A. W. LAUDER recently was made vice president and general manager of the Aurora Metal Co., Aurora, Ill. Mr. Lauder formerly was president of the Trindl Corp. and previous to that was connected with the Lyon Metal Products.

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J. D. LANDIS, assistant to the president, Reading Co., Philadelphia, retired Feb. 1, following many years of service with that organization. SAMUEL R. SICKLE and CHARLES N. LINSON have been appointed assistant purchasing agents of the Reading Co.

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GEORGE B. PICKOP, Malleable Iron Fittings Co., Branford, Conn., has been appointed a member of the rivers, harbors and bridges commission by Wilbur L. Cross, governor of Connecticut. The appointment is to fill out the unexpired term, July 1, 1937, of Myran R. Durham who died recently.

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WILLIAM L. HARTLEY has been made manager of foundry equipment sales, Link-Belt Co., with headquarters at 910 South Michigan avenue, Chicago. Mr. Hartley previously was manager of the Detroit office of that company. HAROLD L. HOEFMAN, previously manager of the company's Indianapolis branch, has been placed in charge of the Detroit office. RICHARD B. HOLMES, of the St. Louis office, has been appointed manager of the Indianapolis sales office, and CARL A. BLOMQUIST, Chicago, succeeds Mr. Holmes at St. Louis, where he will assist HOWARD L. PURDON, manager.

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J. C. MYERS recently was re-elected president of the F. E. Myers & Bros. Co., Ashland, O. Other officers include the following: A. N. MYERS, first vice president; G. D. MYERS, second vice president; F. B. KELLOGG, secretary-treasurer; T. W. MILLER, E. A. McDOWELL and J. C. FRANTZ, directors.

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W. R. GILMORE recently was elected president, Superior Steel & Malleable Castings Co., Benton Harbor, Mich. FRED H. JOHNSTON was named vice president and treasurer; CHARLES A. PRATT, secretary, and W. R. GILMORE, CHARLES H. STRAWBRIDGE, CHARLES A. PRATT, FRED H. JOHNSTON and CHARLES AARON were made directors.

❖ ❖ ❖

PROF. W. A. KNAPP has been named assistant dean of the schools of engineering, Purdue university, Lafayette, Ind. Mr. Knapp has been connected with Purdue since 1908 and since 1922 has devoted the major portion of his time to the organization of various extension activities, with particular reference to engineering conferences on the campus, and throughout the state.

Chicago Meeting To Feature Castings

Recent progress in the improvement and application of malleable cast iron, gray cast iron and cast steel will be discussed at a joint meeting of the Chicago section of the American Foundrymen's association, the Chicago section of the American Society of Mechanical Engineers, and the Western Society of Engineers, to be held Monday, March 18 in the Engineers building, 205 West Wacker drive, Chicago. An interesting program has been arranged in which H. Bornstein, chief chemist and metallurgist, Deere & Co., Moline, Ill., will discuss gray cast iron; D. P. Forbes, president and general manager, Gunite Foundries Corp., Rockford, Ill., will speak on malleable cast iron; and A. N. Conarroe, metallurgist, National Malleable & Steel Casting Co., Melrose Park, Ill., will talk on steel castings. H. F. Allen, engineer, Link-Belt Co., Chicago, will preside at the meeting.

A casting exhibit showing new applications for cast materials and developments in foundry technique and physical properties, will be held in conjunction with this joint association meeting.

Quad City Group Discusses Job Standards

H. C. Robson, Link-Belt Co., Chicago, spoke on "Job Standardization of Foundry Work" at the meeting of the Quad-City Foundrymen's association held at the Davenport chamber of commerce, Davenport, Iowa, Feb. 18. The largest crowd of the season attended.

Mr. Robson discussed the progress which has been made in the foundry industry over a period of years, and pointed to the necessity for creating an automatic method of measuring the actual efforts expended by the worker on the job. He stated that any piece of work entailed three fundamental considerations, namely: Implements used, methods employed, and the time required. In discussing job standardization which involved the time element, four separate phases were discussed, namely: Preliminary work; taking time and motion studies; analyzing studies and setting standards; and applying standards.

The speaker pointed out that in time and motion study work it is advisable to have all who come in contact with the work to understand as much as possible about the particular job. In doing this, a great deal of friction between employes, workmen, foreman, and time study men will be eliminated.

The next meeting of the association will be held at Moline, Ill. on March 18, and will treat a discussion on "Steel Castings and Quality Control."

A. N. Conarroe

H. Bornstein

D. P. Forbes

H. F. Allen

Here's Your Opportunity To Contribute To Foundry Progress

Three Cash Prizes

WE believe many foundrymen will welcome this opportunity to submit an article dealing with some practice of definite value to the foundry industry. It is to encourage such contributions that we are offering three cash prizes. Send your article along promptly. It may win one of the prizes, any one of which is well worth while trying for.

FIRST PRIZE — $100 **SECOND PRIZE — $50** **THIRD PRIZE — $25**

CONDITIONS—

To be eligible an entrant must be affiliated in some capacity with the operating department of a castings plant. No staff member of The Foundry is eligible.

The awards shall be made for the best three articles, giving in detail some practice of definite value to the foundry industry. It should be sufficiently complete to enable a competent reader to duplicate the application. Each article will be judged not upon its literary composition, but upon the value of the contents in advancing an idea in the production of steel, gray iron, malleable, or nonferrous castings. The subject matter covered may be related to molding, coremaking, melting, heat treating, cleaning, rigging, pattern making, mechanical handling or any other practical foundry procedure whereby costs are reduced or castings are improved. Drawings or photographs are desirable, but not essential.

TIME—

Entries will be received from March 15 to August 1.

ANNOUNCEMENT OF AWARDS

Announcement of the awards will be made in the September, Post-Convention issue of The Foundry. Each of the prize winning articles will be published under the signature of the author. The Foundry reserves the right to publish at regular space rates as exclusive contributions, a selection of such other articles as are judged worthy of honorable mention. All contributions should be addressed to Editor, THE FOUNDRY, Penton Building, Cleveland, Ohio.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE — *Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Melting Loss

TO THE EDITORS:

We are interested in the question and answer on page 34 of THE FOUNDRY for February, under the following heading: "Suggest Foundry Loss Should be Kept Below 5 Per Cent", in which the writer goes into the question of foundry loss as outlined under the heading *D* at the beginning of the article. We wish that he had replied as to the thought expressed under the heading *B*.

This states "The furnace loss represented by the difference in weight between the total cupola charge and the total weight of iron recovered from the floor-castings, gates, sprues and scrap". In other words, the actual loss in iron in melting with no reference whatever to the castings being good or bad.

There have been many opinions given along this line, some foundrymen believing that the actual melting loss should not be more than 1 per cent, while others have put it as high as 10 per cent.

If you have any data on this question, we would like to have you present it.

FOUNDRY MANAGER

Alloys Needed

TO THE EDITORS:

We note that your issue of February, 1935 has an item under the heading "Castings Resist Extra High Temperatures" in the Questions and Answers department. In this item it is stated that steel castings should be used for cement kiln nose rings exposed to a temperature of 2000 degrees Fahr. We believe that if the person who answered this particular inquiry had given the matter any thought he would have realized that neither iron nor steel can be used at temperatures even approximating 2000 degrees Fahr. with any degree of success.

Such temperatures call for special alloy castings containing appreciable quantities of nickel and chrome and such castings are being furnished with satisfactory results for the particular application described in this item.

There are about 40 foundries in this country making alloy castings containing at least over 16 per cent chrome and nickel and they are entitled to some consideration in a publication which is supposed to embrace the entire foundry industry.

W. F. FURMAN
Vice president

Duraloy Co.,
New York

A Specialty

TO THE EDITORS:

On page 36, upper right hand corner, of THE FOUNDRY for February, is an inquiry for cast steel kiln ends and you recommend either cast steel or a chrome-nickel steel of about the grade SAE 3140.

Making one piece kiln ends happens to be a specialty of ours. We have made a lot of them which are in use both in this country and abroad. The enclosed circular illustrates one lot which we made for a cement mill in Texas some years ago. We have made a number since for the same company.

These kiln ends, which we cast, are from ¾ inches to 1-inch thick. They are anywhere from 8 to 12½ inches in diameter, from 2 to 4 inches deep, and made in our heat resisting alloy Pyrasteel.

It takes a very high percentage of chrome and nickel because they operate at very high temperature. Of course, they sell at what appears to be a high price, but because of the fuel economy which they make possible, they usually pay for themselves in a few months.

DAVID EVANS

Chicago Steel Foundry Co.,
Chicago.

Quick Test

TO THE EDITORS:

Reading the article on "Porosity" by R. A. Bull, prompts me to tell of a check on porosity, or otherwise on our steel, which I have developed and have in use. It is fast and removes all question of doubt as to whether the metal or the mold or the method of pouring is the cause of pin holes.

The method is as follows: Before pouring the castings, I pour a small test block in a sand mold. A tag is stuck into it and it is at once taken to the laboratory and cooled. It is burned in two with a torch. One half then is retained and the other is pickled in 50 per cent hydrochloric acid (that is the torched inside surface). Twenty minutes in the acid is long enough. It is then washed and wiped dry and examined for pin holes. This can easily be done in half an hour and it works.

W. D. LAMONT

Burlington, Ont.

Cleveland Chapter of Nonferrous Group Meets

Problems pertaining to code administration were discussed at a meeting of the Cleveland chapter of the Nonferrous Foundry Association for Industrial Recovery held at the Athletic club, Cleveland, Feb. 18. W. A. Gluntz, Gluntz Brass & Aluminum Foundry Co., Cleveland, and chairman of the local section, presided.

L. S. Reid of New York office of the Nonferrous association presented an interesting discussion of the work of the association and the code authority of the nonferrous foundry industry. He reviewed the organization of the association and the preparation of the code of fair competition of the industry.

Mr. Reid then outlined the duties of the code authority, which include among other things the collection of important statistics, the handling of complaints of code violations, and the prevention of encroachment by other industries. Mr. Reid pointed out that the members of the industry could help the national office by having a strong, well organized local chapter, and by assisting in performing the duties which are prescribed by law.

Brief talks also were made by Sam Tour, executive secretary of the association, J. A. Duncan, William Duncan Co., East Boston, Mass., T. S. Hemenway, Metal & Alloy specialties Co., Buffalo, and Dan M. Avey, editor of THE FOUNDRY, Cleveland.

Talks on Molding Sand

W. G. Reichert, metallurgist, Singer Mfg. Co., Elizabeth, N. J., addressed the members of the New England Foundrymen's association at a meeting held in the Engineers club, Boston, Feb. 13. Mr Reichert spoke on "Molding Sand".

Changes Company Name

Peerless Sand Co., Conneaut, O., has changed its name to the Peerless Mineral Products Co., to better describe its line of materials for foundry use. Management of the company remains unchanged with F. L. Moore, president, and general manager.

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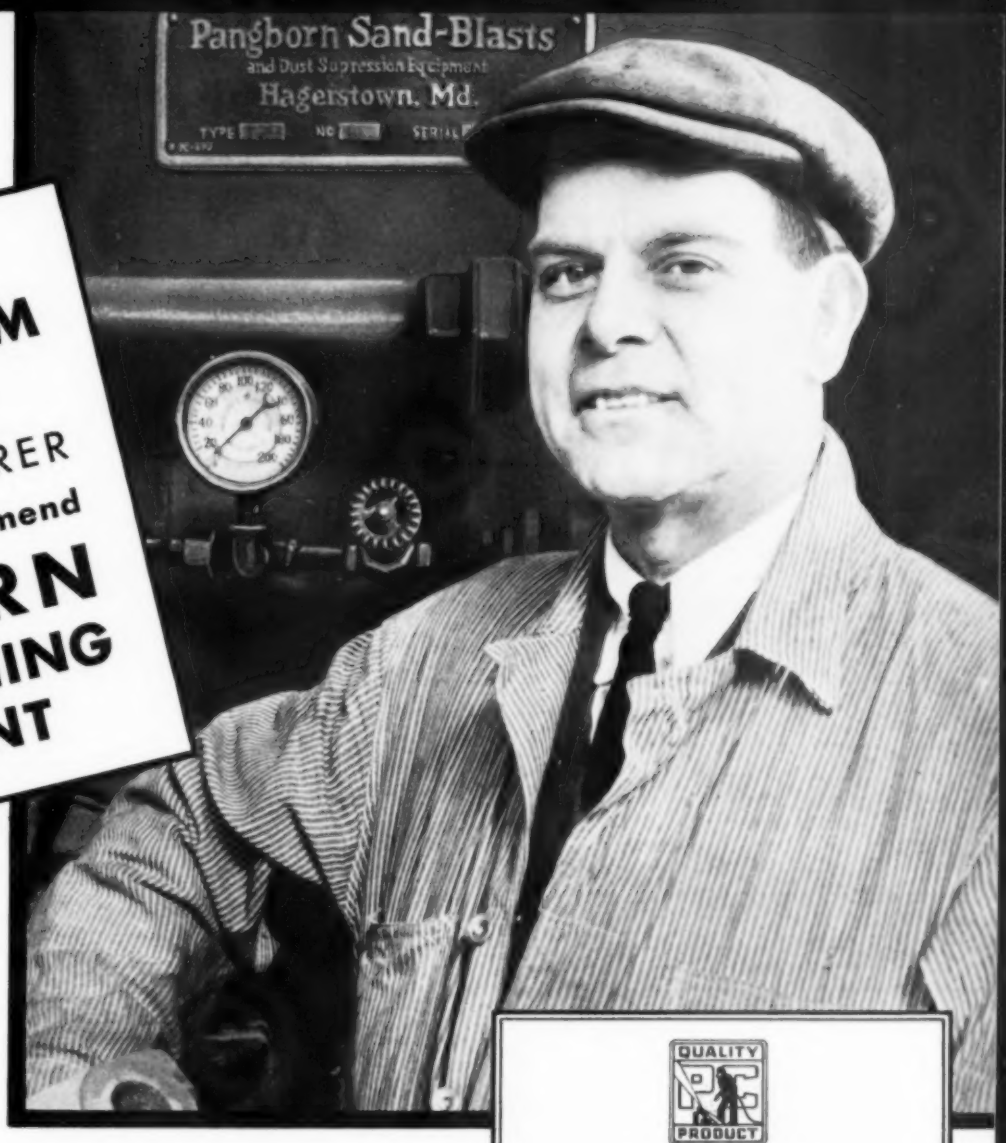

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Prevent Losses with

Proper Gates and Risers

By PAT DWYER

IN RECENT years the practically universal custom is to provide aluminum pattern plates with one half of the pattern in the cope and one half on the drag side. A variation of this method is found where it is found expedient to work two men side by side. In this instance two pattern plates are provided, one with the cope patterns and the other with the drag patterns. One man makes the drags and the second man places the copes on top of them.

The number of patterns on a plate, their disposition and the manner of gating constitute one of the major problems of production. Maximum production calls for as many patterns as can be crowded on the plate, but frequently the number must be modified to come within the fluidity range of the metal, and to meet other requirements. This is particularly true with pipe fittings subjected to high pressure in service.

In addition to the usual hazards of cold shuts and misruns, incident to any attempt to distribute molten metal to a great number of mold cavities in a single flask, other and more insidious forms of defect confront the manufacturer of high presure fittings. Minute cracks, internal or external, or, small, spongy areas of no moment in many lines of castings, are sufficient to condemn any casting of this character. Absolute perfection, so far as it lies within the limits of human achievement is the constant aim of the malleable foundryman.

Micrometer inspection constitutes another limiting factor in several phases of the manufacture of these castings, and this includes the arrangement of the patterns and gates on the plate. The castings are machined in automatic machines, fed from a magazine and may be rejected if they vary from a tolerance of 0.003-inch, approximately the thickness of a newspaper sheet or a human hair.

Manifestly patterns, coreboxes, cores and molds must be made with the greatest accuracy to meet such exacting standards. The skilled patternmaker can proceed cautiously to bring his pattern and corebox to the desired degree of accuracy, but his efforts may be nullified by the manner adopted in forming the molds and cores. Cores may be distorted while in the green state and the molds may be distorted during the pouring process, if the sand betwen the individual castings is not sufficient in volume and density to resist the pressure of the metal, or if the outside of the mold is not reinforced adequately.

Instead of striving for a maximum number of patterns on a plate, the number is limited in conformity with the foregoing conditions. In many instances hinged snap flasks serve satisfactorily, while in others the familiar one-piece tapered flask which strips from the mold, finds favor. Wood jackets are not as reliable and accurate as the tapered metal jackets pressed down around each sand mold before the metal is poured into it. By shifting the jackets according as the molds are poured, a comparatively small number will serve a floor containing from 100 to 200 molds. The same of course applies to a greater extent to molds poured on a conveyor.

In a typical pattern plate for 1½-inch elbows the patterns are arranged in two groups of four and two pairs, a total of 12 in a 13 x 16-inch flask. Incidentally patterns of that kind invariably are grouped in twos and fours so that the cores may maintain their proper positions without the use of chaplets. Metal from the sprue flows through a single runner in the center and is distributed through a series of gates, each one of which enters the mold cavity alongside a core print in the drag. The horizontal runner leading to the gates is located in the cope, where it serves as a feeder. Additional feeding metal is supplied by shrink bobs or blind risers located above the gates close to where the metal enters the mold cavities.

To a person unacquainted with the peculiarities of malleable iron while passing from the molten to the solid state, this elaborate system of gating appears extravagant and wasteful. The amount of iron required to fill the gates and risers, equals and in some instances exceeds the amount in the castings. However, experience has shown it is an actual requisite in the production of sound, homogeneous castings, capable of passing the rigorous tests imposed, and of functioning satisfactorily in service.

As stated previously, the speed at which the metal is introduced to the mold is an important factor. If it is poured too fast, the mold walls will yield to the pressure and over size castings will appear. If it is poured too slowly, it will freeze before all the mold cavities are filled. The knack of pouring in the most efficient manner can be acquired only through actual experience. The man pouring the metal has to acquire an instinctive *feel* for the balance and swing of the ladle.

An interesting application of gates and risers designed to prevent internal segregation in a pair of 4-inch T castings is shown in Fig. 266. When these castings were gated simply at one end in the usual manner, a slight *draw* or discolored area usually appeared in the angle between the branch and the main body at the opposite end. This defect was not apparent on a casual inspection. It was discovered only after the casting was broken into several pieces. Common practice in malleable foundries sanctions this method of discovering hidden flaws, minute internal defects. In the regular routine inspection, selected castings deliberately are broken and

(*Continued on page* 47)

Don't Crowd

THE problem of mounting the correct number of patterns on a plate hinges on many factors. Desire to secure maximum production induces the foundryman to crowd the patterns as closely as possible. In some instances, particularly on small plain castings the patterns may be aranged with only the narrowest margins of sand between them. In others where the factors of shrinkage and venting play a prominent part the correct spacing of the patterns involves a nice sense of judgment based on practical experience. Pipe fittings designed for severe service under high pressure must conform to such exacting specifications that every precaution must be taken to insure solid, homogeneous metal throughout. This involves placing the gates in the most favorable position for filling the mold rapidly, and the placing of ample feeders at the proper points to compensate for shrinkage.

ADVERTISING PAGES REMOVED

(*Continued from page* 44)

the various fractured surfaces are examined closely.

This example is presented as typical of many in which a defect is due to no apparent cause. Mold, cores, metal show no variation from those employed for other castings that show no defect. In this particular instance a theory finally was advanced to the effect that the slight difference in temperature in the metal at both ends of the casting was responsible for the trouble. Acting on this theory a new set of gates and shrink bobs was tried as shown in Fig. 266. Subsequent castings showed no sign of the former defect.

The metal is poured through a central sprue *A* in the cope. A horizontal runner *B* above the joint line in the cope carries the metal to a pair of large shrink bobs *C* which also extend into the drag. A small gate *D* at each end of the casting admits the metal from the shrink bob to the mold cavity. It is plausible to assume that the feeding effect of the extra risers supplement the favorable effect secured through equalization of temperature throughout the casting.

Presence of dirt or slag in a casting frequently is the cause of arguments between the molder and the inspector. One claims that the dirt was in the iron, while the other claims that whether the dirt was in the iron or the mold, the molder is responsible for its presence in the casting. The character of the material showing in the dirty area, usually, but not invariably is sufficient indication of its origin. In many cases the sand particles are clearly defined, while in other cases the sand may be partly fused and without a microscopic examination cannot be distinguished from slag. A close check up on the molding and pouring practice is required to settle this point.

A set sprue is preferable to a sprue punched with a tube, but in either case the lower end of the opening should be examined before the mold is closed. Where the sprue is formed with a sprue cutter a more or less ragged edge is left at the bottom. The molder usually runs his finger or a small tool around this edge to remove the broken or ragged edge. If this precaution is omitted the first metal washes the loose sand into the stream and carries it into the mold where it either lodges against some projection or floats to the top.

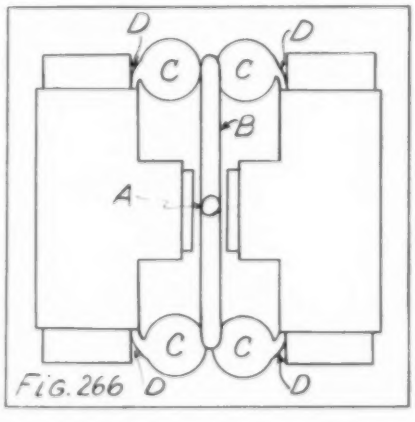

Fig. 266—The metal enters the castings through shrink bobs at both ends

Slag occasionally floats in with the metal, but this in many instances is due to carelessness and the peculiar trait of human nature which enables a man to wait five minutes for a shank of metal, but which prevents him from taking 5 seconds to skim the metal before he pours it.

In one of the earlier sections of the present series dealing with the classification of gates, their shapes and applications, reference was made to the type known as a whirl or spinner gate. This type of gate is employed principally in gray iron foundries, but it also finds application on many types of castings made in malleable iron foundries. As with many devices, including gates, there is a wrong way and a right way to form a whirl gate. The object of the gate is to impart a whirling motion to the stream of iron as it passes through. The whirling motion sets up a centrifugal force and as a result, slag or other foreign inclusions of lighter specific gravity than the iron, remain in the center of the whirlpool, while the clean iron from the outer rim flows into the mold.

To reap the full benefit of this operation, the gate or passage by which the metal flows into the mold cavity should be located fairly close to the entrance passage, and should point in a direction to draw metal in the opposite or nearly opposite direction from which the metal is revolving in the whirlpool. The correct position is shown in the lower illustration in Fig. 267 where *C* is the passage from the sprue to the whirlpool and *D* is the gate proper, or passage leading to the mold cavity. Direction taken by the whirling metal is indicated by the arrows. The whirl gate shown in the upper part of the same illustration is not so efficient since the metal entering at *A* has the opportunity of flowing directly or almost directly into the gate *B* leading to the mold before the anticipated centrifugal force begins the separation of foreign inclusions. The whirlpool chamber is made by mounting a half sphere on the cope side of the pattern plate and the other half sphere on the corresponding drag side. For best results the metal enters the lower half and leaves from the upper half. Where additional pressure is a desirable feature a sprue approximately the same diameter as

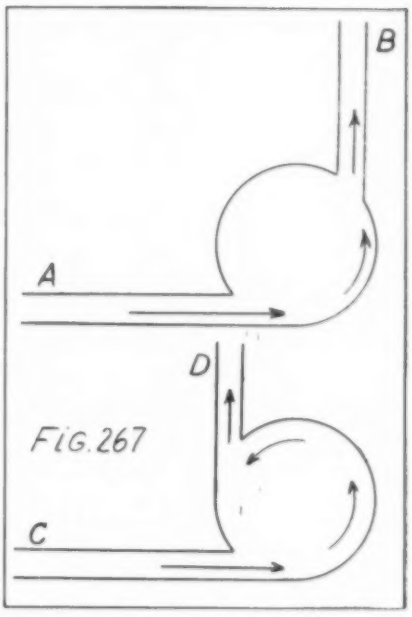

Fig. 267—Above is the incorrect and below is the correct method of forming a whirl gate

the ball forms an opening to the top of the cope.

Occasionally instances are found where the metal and the gates are perfectly clean, yet dirt appears in the casting. This may be caused by the metal stream flowing directly against a core or other projecting part of the mold face. Some of the sand is removed by erosion and contaminates the metal in the casting. Usually this condition may be remedied by changing the position of the gate, or by attaching it in a manner that will permit the metal to enter the mold in a tangential direction.

Size and shape of the gates are worthy of careful study, but the fact also should be borne in mind that however well a gate may be placed, unless sprue, runner and gate are kept filled with metal, the risk of producing dirty castings is present. This is the main reason for constricting the gate passage at some convenient point. The gate opening is larger than the constricted area to permit the metal to flow gently into the mold. The constriction will prevent the metal from flowing through the gate in greater volume than it can be supplied through the sprue. In this manner the passage from the pouring basin to the constricted area in the gate may be kept filled during the entire pouring period.

While shrinkage in small malleable iron pipe fittings sometimes may be traced to the composition of the metal, this is unusual if the proper precautions are used in the selection of the raw materials and in the melting practice. The tendency of the metal in such cases would be to show sluggish character-

istics shortly after removing from the furnace, and the appearance of pin holes in the castings.

Due to the relatively low freezing point of the white or hard iron used in malleable practice, the mold cavity must be filled as rapidly as possible. Therefore the sprues, runners and gates must be of ample size to fill the mold quickly. Also sufficient head of metal must be maintained to feed the casting during this short period, otherwise the gate or runner may have a tendency to draw metal from the casting instead of fulfilling the anticipated function of feeding metal into the casting.

Gates should be attached to the heavier portions of the castings so that these portions will receive a constant supply to compensate for the natural shrinkage as they solidify. If this is not done, the thin sections which freeze first will be solid and the other parts due to insufficient feeding will show shrink holes. In some cases, especially with complicated or otherwise difficult castings, shrink balls or blind risers close to the casting are employed to insure reservoirs of feeding metal. Pouring unfed castings too hot increases shrinkage.

Shallow copes may cause shrinkage defects due to insufficient head as pointed out previously. Improper arrangement of patterns on the plate which permit castings to be run or fed from other castings may result in the same form of trouble. Changing the sprue from an outside to a more central location will provide better feeding and eliminate shrinks in castings which previously were fartherest away from the sprue. Where the cope appears to be too shallow, the height of the metal in the sprue may be increased by using a runner cup 2 or 3 or more inches in height. This may be formed either in green or dry sand. Sometimes all that is required to cure certain forms of shrinkage is to increase the thickness of the runner and gates. Where the gates form part of the pattern equipment, this thickening up experiment first may be tried by removing some of the sand from the gate passages in the sand with a tool. Observation of the effect will indicate whether or not the pattern equipment should be changed. Of course, as pointed out on several former occasions, uniformity of section is one of the most important factors in securing malleable castings free from shrinkage defects. In reality the proper time to prevent segregation and shrinkage in many malleable iron castings, is while the drawing is on the board or while the pattern is in course of construction.

The small malleable casting shown in Fig. 268 is typical of many in which shrinkage trouble develops with a change of gating designed for greater production. In the former arrangement where the casting was gated close to the neck comparatively little trouble was experienced from castings breaking on account of shrinkage. Almost constant trouble followed a change of gate from the neck to the end. Several solutions

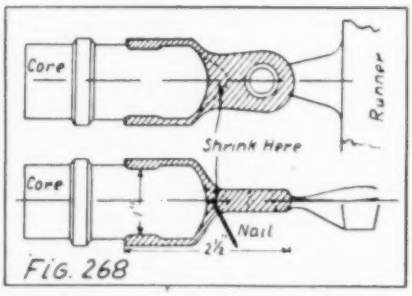

Fig. 268—Alternative methods of preventing shrinkage at the neck

are available for a problem of this kind. The most obvious is to change the gating system back to the style in vogue when the castings were satisfactory. However, occasionally other factors may prevent adoption of this plan.

Shrinkage takes place at a point in the casting where the metal is thicker than it is at any other point. Evidently then the problem is to equalize the thickness, or, introduce some element in the mold that will cause the metal in the thick section to set as rapidly as the metal in otaher parts of the casting. One suggested remedy is to extend the inner end of the core as shown by the dotted line. This will remove the heavy body of metal and cause the casting to set more uniformly. A second remedy is to leave the core as it is, but insert a nail in the drag side of each mold with the head projecting into the mold cavity at the neck. The nail will cause the metal in the heavy section to congeal more rapidly than otherwise would be the case. A third remedy is to cast the neck in a chill. A close examination may show that the gate is sucking iron from the casting instead of feeding it. A higher head and gate entirely in the cope will overcome this trouble.

This is the sixty-first of a series of articles dealing with the various types of gates and risers used in the foundry industry. The sixty-second instalment will appear in an early issue.—THE EDITORS.

Moves Chicago Office

Laclede-Christy Clay Products Co., St. Louis, has moved its Chicago district office from 776 Peoples Gas building to its new headquarters and warehouse at 4452 West Fifth avenue. H. R. Hiller is in charge of that office.

Plaster Pattern Used For Forming Slush Mold

In the production of slush castings a bronze mold is made in two or more sections depending on the number of undercuts on the proposed casting. The parts are hinged or joined in another suitable manner to insure accurate alignment when assembled. The entire mold is mounted so that the opening for the entrance of the metal is at the highest point.

The operator pours a white metal mixture into the mold and allows it to stand for a certain time, usually from 10 to 20 seconds. This point can be determined only by experiment and naturally will vary with the type of casting and the thickness of metal required. Having determined the time by pouring a few experimental castings, the operator fills the mold with metal, allows it to stand the allotted time and then inverts the mold over a suitable receptacle. The surplus metal flows out leaving a shell casting in the mold. The mold then is opened, the casting removed, the mold is closed and the operation is repeated.

Briefly, that is the routine, but a considerable degree of skill and knowledge are required in gaging the temperature of the metal and in the manipulation of the mold. Usually two pots of metal are maintained in the vicinity of the mold. The operator dips the metal from one pot and pours it into the mold repeatedly until the supply is exhausted. In the meantime the surplus metal from the mold is poured back into the second pot and raised to the required temperature. This arrangement insures continuous operation.

Usually a wax or clay model is required for the original pattern. If the object to be reproduced is hard and firm it may be used. The necessary parting lines are marked on the object and then plaster of paris is cast in the shape of blocks all around the object. These blocks are removed and tooled to the required shape on the outside. If necessary the inside also is retouched. Each of the blocks then is treated as a pattern and a casting is made from it. The castings are machined and fitted together to form the complete slush mold.

Offers Line of Sand Mixing Machines

B. O. Bartlett & Snow Co., 6200 Harvard avenue, Cleveland, is handling the sale and distribution of the Lancaster type sand mixing machine. A feature of that type of machine is a revolving pan which carries the sand and one or more plows and mullers moving in a counter direction. The machine is described in the August 1934 issue of THE FOUNDRY, on page 67.

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Castings for Severe Service

Symposium on metals for the petroleum industry features meeting of A. I. M. E.

SEVERAL papers of interest to the foundry industry were presented at the 144th meeting of the American Institute of Mining and Metallurgical Engineers, New York, Feb. 18-20. These were presented before the iron and steel division, and sessions of the Institute of Metals division. Of considerable interest also was the two-session symposium on the use of metals in the petroleum industry.

Special features of the convention program included the annual lecture by Dr. C. A. Edwards, professor of metallurgy, University college, Swansea, Wales, entitled "Gases in Metals," and the Howe Memorial lecture by Earl C. Smith, chief metallurgist, Republic Steel Corp., Youngstown, O., on "Some Studies of Problems in Steel Melting."

Copper in Malleable Iron

Henry A. Buehler, state geologist and director, Missouri bureau of geology and mines, Rolla, Mo., was elected president of the institute. John M. Lovejoy, president, Seaboard Oil Co., New York, and Dr. Paul Dyer Merica, assistant to the president, International Nickel Co., New York, were elected vice presidents. Newly elected directors are: Dr. Charles K. Leith, professor of geology, University of Wisconsin, Madison, Wis.; Edwin E. Ellis, vice president of the United States Steel Corp., New York, in charge of mining, raw materials and lake shipping; Wilber Judson, vice president, Texas Gulf Sulphur Co., New York; Wilfred Sykes, assistant to the president, Inland Steel Co., Chicago; and R. M. Roosevelt, vice president, Eagle Pitcher Lead Co., New York.

Discussing some effects of copper in malleable iron, Cyril Stanley Smith and Earl W. Palmer, copper alloys research laboratory, American Brass Co., Waterbury, Conn., declared that by dilatometric and other methods, the addition of copper has been found to accelerate both first stage and second stage graphitization of white cast iron. The effect, the authors stated is roughly proportional to the amount of copper added, and 1 per cent of copper results in a reduction of graphitization time by about 50 per cent, although this is affected by the rate of heating and other fatcors.

The addition of 1 to 1.5 per cent of copper increases the yield point of malleableized iron to the extent of about 10,000 pounds per square inch, and a further gain of 10,000 to 15,000 pounds per square inch can be obtained by subjecting the castings to a precipitation—hardening treatment. This consists, they concluded, of heating to a temperature closely below the critical point, air cooling and reheating at about 500 degrees Cent. The increase in tensile strength is accompanied by some loss in ductility.

A simple method for determining the solubility of nitrogen in liquid iron has been devised, according to John Chipman and Donald W. Murphy, department of engineering research, University of Michigan, Ann Arbor, Mich., who outlined work in the development of that method. K. Heindlhofer, research laboratory, United States Steel Corp., Kearny, N. J., presented a paper on the "Plasticity of Iron at Low Temperatures."

That the specialty alloy steel foundry will eventually be at a better advantage to produce castings in the 4 to 6 per cent chromium alloy group than the ordinary steel foundry was the prediction of one metallurgist at the symposium on the use of metals in the oil industry.

According to W. F. Furman, the Duralloy Co., Pittsburgh, a slight change in analysis may result in improvement of steel castings, a case in point being the 18-chromium, 8-nickel steel, not an especially desirable combination from the foundrymen's standpoint. Better results have been attained by increasing the percentage of both in the casting, especially chromium, according to Mr. Furman. Corrosion resistance is somewhat increased and higher chromium content makes for a possible higher content of carbon and as a rule sounder castings.

Castings for high temperatures are mostly for tube supports, beams, hangers, etc., in oil-cracking stills and must maintain considerable loads for indefinite periods; resisting oxidation at high temperatures. Such material also must be fairly immune to corroding action of sulphur gases. Safe load figures by several producers of castings, reasonably close to analysis, favor an alloy of 24-26 chromium and 10-12 per cent nickel at several working temperatures with a minimum of 24 per cent chromium to insure satisfactory oxidation resistance.

Tungsten in small amounts, 2 to 4 per cent, added to 24 chromium and 12 nickel steel for tube supports increases the initial high temperature strength of the alloy, but its effect over long periods of exposure is less certain. Such equipment may feel effects of tungsten loss after several hundred hours, especially if temperatures above 1600 degrees Fahr. are encountered. Molybdenum has a decided value when added to chromium-nickel alloys, particularly in the 18-8 range, when resistance to corrosion is important. The value for high temperatures is uncertain. Titanium in small quantities is beneficial in resistance to embrittlement.

Use Centrifugal Process

Some foundries are casting tubular forms by the centrifugal process. A dense casting is attained, a fine grain secured with walls uniform and strength increased. Another advantage is an inside diameter concentric with the outside. Gas pockets, interior shrinks and other defects are eliminated.

Among the highly alloyed cast irons, the austenitic type, containing 14.0 per cent nickel 6.0 per cent copper and 2.0 to 3.0 per cent chromium finds application for refinery equipment parts, including pump and valve bodies and trim in pipe line equipment where resistance to corrosion is important, according to Albert G. Zima, development and research department, International

(*Concluded on page* 53)

ADVERTISING PAGES REMOVED

(*Concluded from page 50*)

Nickel Co., New York. A modification of that material with a tensile strength range from 60,000 to 100,000 pounds per square inch is being developed for pipe line flanges and bolts subject to severe corrosion. Alloy cast iron also is used extensively for working barrels and plungers for oil well pumps. Alloy cast iron for pistons, cylinder liners and valve plate covers in a slush pump has 1.25 to 1.75 per cent nickel and 0.30 to 0.40 chromium. These are machined readily and have a tensile strength of 45,000 pounds or more, being uniform in density and hardness throughout the heaviest sections.

The alloy steel foundry, through research and experiment also has worked out problems to meet demand of the refinery pump designer. Such research with alloys covering more than 10 years, has stimulated efforts to produce better low-carbon castings. The average foundry product, as a result, shows a marked improvement over former standards, according to A. E. Harnsberger, Pure Oil Co., Chicago, who said in part:

"It should be remembered that, because of the greater number of operations required in the production of alloy castings, the time required for delivery, as compared with low-carbon castings, is necessarily longer. Since the use of alloys in refinery pumps is a matter of economics, and since volume and production has a great effect on costs, it is important that future requirements be held to as a few different alloys as possible, so as to enable the casting manufacturer to secure as high a volume as possible of a single alloy and avoid a larger number of smaller melts. Pump manufacturers should survey the entire chemical industry and determine whether the bulk of the conditions cannot be met by a few alloys that can be produced in larger quantities at lower costs."

Steel Is Tender

Steel foundry practice and problems as involved in the production of alloy castings were discussed by the speaker and included general observations: In general, the high-chromium and high chrome-nickel steels have poorer castability than carbon steel. Relative castability and behavior when pouring depends upon their composition, but design of the casting, thickness of metal sections, uniformity of the adjoining sections, have an important influence on the foundry's efforts to produce satisfactory and reliable castings. Although the 5 per cent chromium steels containing small percentages of molybdenum or tungsten are not usually classified with high-chromium and high chrome-nickel steels, they perform service as distinguished from plain carbon steels in oil and steam service. The foundryman regards them as *tender;* hard to handle in the mold and they have to be treated respectfully in the cleaning and finishing shop. Mr. Harnsberger said. They have a greater tendency to crack in the mold than the 13 per cent chrome steels. The 5 per cent chromium alloy is air hardening, and as such receives, as a rule, more extensive heat treatments. The 13 per cent chromium alloy is less tender than the 5 per cent chromium alloy, has a narrower range of fluidity, and must be watched more carefully to obviate porosity in the castings. This condition is particularly pronounced when the carbon content is low.

Nickel is the most common alloying element used in conjunction with chromium. The most common of the chrome-nickel alloys is the 18 per cent chromium, 8 per cent nickel composition, which has better castability than the straight chromium or other chromium nickel alloy steels, customarily used in pump manufacture. It has excellent fluidity, only slight tendency to crack in the molds, and good welding properties.

Casting Magnesium Alloys Requires Care

Magnesium and its alloys have a great affinity for oxygen when molten, and therefore, considerable care must be taken in melting and molding. Magnesium also dissociates water when molten, and the molds either must be thoroughly dried, or a protective agent added to the sand, or some other liquid than water used to moisten the sand.

Magnesium fortunately does not combine with iron but does with silicon. Consequently cast iron, wrought iron or steel pots are used. Cast iron pots are suitable where large quantities of metal are not required to be melted, otherwise the weight of the pot tends to militate against the use of cast iron. Fluxes used to cover the metal during melting and pouring usually are composed of magnesium chloride with other salts to thicken it. One mixture suggested for that purpose is composed of 1½ ounces of calcium fluoride, 2 ounces of sodium fluoride, 11½ ounces of potassium chloride, and 2 pounds of anhydrous magnesium chloride. The flux should be mixed, melted and poured into ingots before using. It is hygroscopic and must be protected from atmospheric moisture. After ingoting, all the material may be broken up or ground, or only an amount sufficient for immediate use. Keep in tightly covered cans, etc.

A small amount of the flux is placed in the pot with the ingots, and allowed to melt down with the metal. The amount added is just enough to give a thin covering. When all the metal is molten, the flux is stirred into the metal with an iron stirrer to remove the impurities, etc., and a little more flux added. The metal then is raised to the proper temperature and is ready for pouring. Pouring temperatures will range from 1200 degrees Fahr. for medium and heavy castings to 1450 degrees Fahr. for extremely light work. The metal in the furnace of course, will have to be at a higher temperature, but it is advisable not to let it get more than about 50 degrees above the pouring temperature.

As mentioned previously, dry sand molds may be used, and before baking it is suggested that the mold faces be sprayed with a solution of sodium silicate or water glass to provide additional binder at that point. Cores also may be sprayed with silicate before baking, and it is claimed that the silicate coating on mold and core gives smooth-skinned castings. A variety of methods have been suggested in which green sand molds may be employed for magnesium and its alloys. In one powdered sulphur in small amounts and boric acid in lesser amounts is mixed with regular molding sand which should be fairly coarse and permeable. Sulphur also forms the binder in the cores, but as they are baked less sulphur is required. Baking temperature should not be over 200 degrees Fahr. to prevent loss of sulphur. The sand for cores is the same as for the molds.

Other substances than water for moistening the sand have been suggested and they include glycerine, ethylene glycol, or rosin dissolved in kerosene and napthalene. The sand in which the substitutes are used, of course, is dried previous to adding the nonaqueous substances.

The castings must be fed properly as is the case with any metal. Where heavy and thin sections are in the same casting, the heavy sections should be well risered. It also may be advisable to chill those sections in addition to the feeding. Where direct feeding is difficult, chills may be used, and these may be brass, aluminum with 5 per cent iron, cast iron, copper, or magnesium. Player advises that the chills be coated with fine graphite in denatured alcohol.

In pouring, the flux should be held back with a stirrer, and the lip of the pouring ladle held as closely as possible to the sprue opening. Keep the sprue filled with metal. Gates should be attached so that the metal is led into the cavity with as little disturbance as possible. For that reason bottom gating is preferred although with care in pouring other gating may be used.

Fig. 1—Metal is brought from the melting department to the molding floor on a monorail conveyor

Makes Bathroom Fixture Castings

By J. B. NEALEY

POPULAR demand for beauty in the bathroom has been the principal controlling factor in the design of new bathroom fixtures during the past few years. Naturally this more or less has involved and added to the processes in both foundry and machine shop, but the problems, incident to these changes have been, or are being, solved satisfactorily.

One product in particular, which is being designed to increase utility as well as enhance decorative value, is a bathtub fixture, through which water is supplied to either the faucets or the overhead shower by turning a single lever. It consists of a single casting the entire inside of which is opened up with but one core, so that five outlets are left. Two of the outlets are threaded and three are tapped. The fixture is provided with a renewable seat in the bottom compartment. The entire valve assembly and connections are made in front of the tile wall, instead of being buried in the wall, and are concealed behind a chromium plated cover. Core, casting and finished product are shown in Fig. 2 at the right.

The valve shown was developed by the Schulte Brass Mfg. Co., Cincinnati. That concern makes a full line of plumbing fixtures and operates a foundry, machine shop and plating division as well as an engineering department. The foundry is housed in a modern brick building divided into melting room and pouring department. An overhead monorail with chain hoists serves both departments. Three melting furnaces are used, one stationary and the others of the tilting type as shown in Fig. 3. All utilize gas fuel. The stationary crucible is of the standard type, cylindrical steel furnace lined with refractory brick, and holds a No. 60 crucible. Heat is supplied through a single gas burner of the premix type using a motor driven mixer for the gas and air.

The molten metal is transferred to the molding room by lifting the crucible out of the furnace with a hoist

(*Concluded on page* 56)

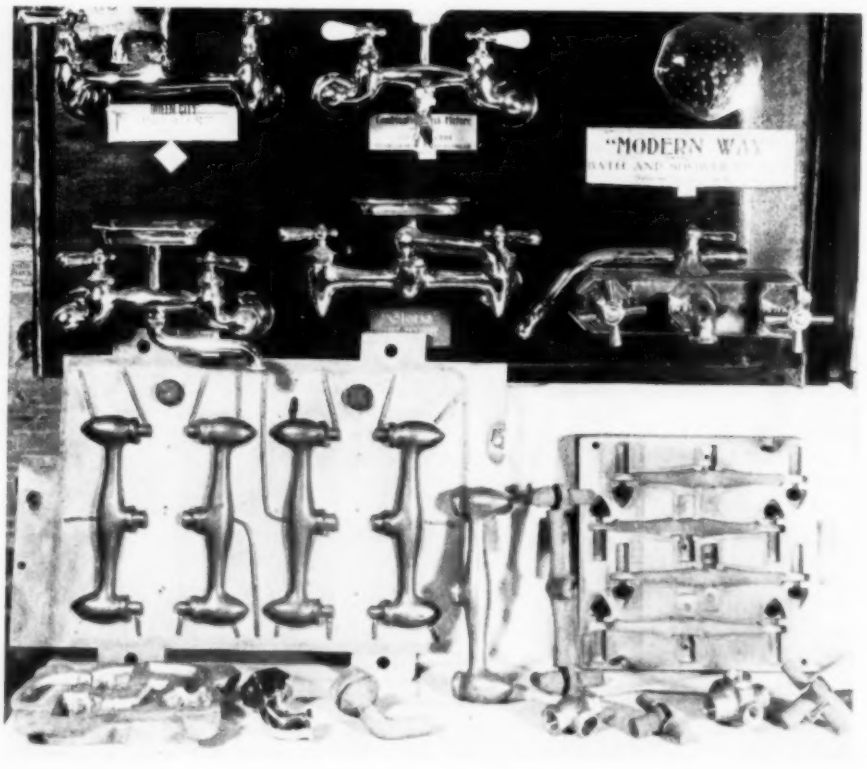

Fig. 2—Illustrating the type of patterns and core boxes used in production and products of the company

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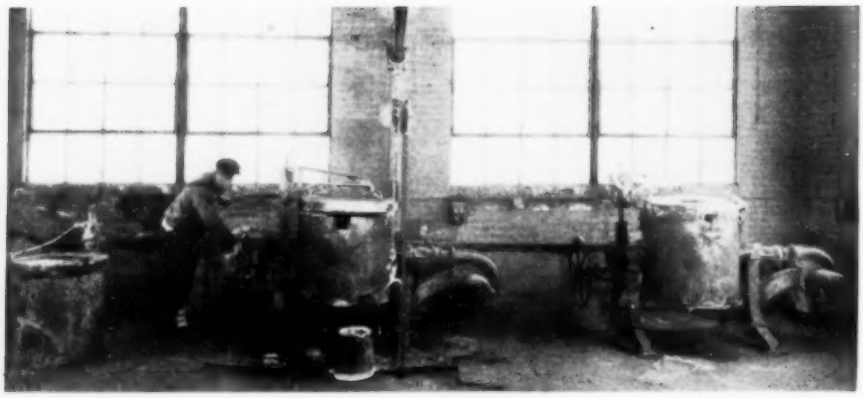

Fig. 3—Metal is melted in three gas fired furnaces, one of the stationary and two of the tilting types

(*Concluded from page* 54)

operating on an overhead monorail system. The tilting furnaces are much the same except that they are suspended by trunnions between two cast iron uprights or frames and are equipped with a hand wheel and worm for tilting.

These furnaces are about 4 feet in diameter and 4 feet high and hold crucibles with a capacity for 500 pounds of metal each. Each furnace is fired with a single gas burner, which in turn is supplied with a mixture of gas and air by a motor-driven blower-mixer. The tube through which this mixture is forced is so placed as to be an extension of one of the trunnions and will rotate with the tilting of the furnace. The tube is bolted to the frame. The gas burner is L-shaped, the burner portion being cemented into the furnace wall while the end of the L is welded into the tube, and is thus supplied with the combustible mixture. This combines rigidity of construction with flexibility of operation. Sometimes a rubber hose is used to gain flexibility with this type of furnace. The furnace cover swings from a post and easily is removed and put in place. Contents of these furnaces are poured into ladles which are moved to the molding room by the monorail and hoists.

The entire plant and equipment is laid out so as to have straight-line production from melting to plating. In the molding division both bench and machine molding are employed, the machines being of the pneumatic, roll-over, jolt type. . Sand is reconditioned in a motor operated sand riddle. Matchplate patterns are used in all of the fixture work. Molds are placed in racks arranged in rows in the center portion of the building as shown in Fig. 3, and poured as described.

That portion of the molding department furthest removed from the melting room is equipped with sprue cutters, grinders, tumblers, sandblasting equipment, etc. The core room is shown in Fig. 4. Cores are made in boxes shown in Fig. 2 and then baked in iron trays, which may be seen in Fig. 4. Three gas-fired core ovens are used. These are of sheet metal construction with five shelves and each is about 5 feet high, 4 feet wide and 3 feet deep. Four gas burners are located in the bottom of each and ventilation is secured through ducts in the rear.

Another product turned out in quantities by that company is a sink faucet with a swinging spout, the inside of which is opened up with a single core. This core is made up in cast iron boxes, four to a box, and baked before removing. Metal patterns on both sides of the plate, four to a plate, are used to make the impressions in both the cope and drag. The casting has five outlets, two threaded to receive the water connections, two tapped for the hand valves, and one tapped for the delivery spout. The core box, the core, the pattern plate, the casting and the finished product are shown in Fig. 2.

A method of casting in a mold made with foundry sand and cement, is finding increased favor especially for steel castings in France, according to a report by Consul Robert D. Murphy, Paris.

Steel Founders Elect New Directors

Steel Founders' Society of America, at a meeting in Cleveland, Feb. 13, announced the election of the following directors: District 1, Harrison Hoblitzelle, General Steel Casting Corp., Eddystone, Pa.; alternate, L. C. Wilson, Reading Steel Casting Co., Reading, Pa.; district 2, Keith Williams, Pratt & Letchworth Co., Buffalo; district 3, J. W. Glover, Glover Machine Works, Marietta, Ga.; district 4, D. C. Bakewell, Continental Roll & Steel Foundry Co., East Chicago, Ind.; district 5, E. L. Brooks, Sawbrook Steel Casting Co., Cincinnati; district 6, Joseph O. House, National Malleable & Steel Castings Co., Cicero, Ill.; alternate, L. F. Peregoy, Sivyer Steel Casting Co., Milwaukee; district 7, Paul H. Leussler, Omaha Steel Works, Omaha, Nebraska; alternate, Burtner Fleeger, Oklahoma Steel Casting Co., Tulsa, Okla.; district 8, J. P. Arnoldy, Warman Steel Casting Co. Ltd., Huntington Park, Cal.; alternates, R. E. Noack, Monarch Foundry Co., Stockton, Cal. and T. R. Hinton, Olympic Steel Works, Seattle, Wash.

F. A Lorenze Jr., American Steel Founders, Chicago, was re-elected president of the society; Merrill G. Baker executive vice president, and R. L. Collier, secretary and treasurer.

Secures Russian Orders

British manufacturers have received orders from the Soviet Union for machinery and equipment totailing £1,000,000 according to a recent report of the American Consulate General, London. In addition to orders for goods, large purchases have been made on the British market for re-export goods, mainly from British colonies and the Dominion. The contracts are on a cash basis.

Fig. 4—View of the core room showing ovens, core boxes and dryers

ADVERTISING PAGES REMOVED

Specializes in Alloy Cast Steel

(*Concluded from page 20*)

for conveyor units in a practically unlimited range of sizes and shapes, to meet any given analysis or any specified operating conditions. Instead of a split pattern and a two part mold and flask, a short section of a complete pattern is employed to form the mold inside as many dry sand cores as may be required for any given length of casting. In this manner the process is simplified greatly and the castings are produced without any unsightly fins.

Use of the term core in this particular instance is somewhat ambiguous since the blocks of sand referred to as cores contain the mold cavity designed to be filled with metal to form the casting. However, since these blocks of sand are prepared in the core room from a core sand mixture, dried in the oven, and moreover, since universal foundry custom favors the use of the term *core* for all blocks of sand prepared in a similar manner, it would seem that no choice remains but to continue calling them cores. This digression is introduced for the benefit of any nontechnical reader. Practical foundrymen through long usage readily recognize a core whether it is designed for use inside or outside a casting.

Castings Made in Cores

Cores for conveyor screws are assembled in line on a suitable foundation inclined at an angle of approximately 20 degrees and with an upright member at each end. The metal enters through a gate at the low end. One advantage of the method is that no flasks, frames, curbing, clamps or weights are required, with the exception of a wood wedge between the end core and the upright plate. Actual molding and casting operations are exceedingly simple, but the construction of the pattern and corebox involves some nice calculations and the most accurate workmanship.

Assuming that the screw is uniform in pitch and diameter throughout the entire length, the patternmaker decides on the length of corebox which in multiple will form the entire length of the casting. This box is open top and bottom, provided at one end in the center with an extension bearing or guide for the shaft and at the opposite end with a stripping plate through which the screw pattern is withdrawn.

In making the core the corebox with the section of screw fitted in place is placed upon a flat plate. The box then is filled with an oil core sand mixture which is rammed to the required density and the superfluous sand is scraped off flush with the top face of the box. Guided by suitable marks a flat tool is driven down through the sand to form a vent opening or whistler on the highest points on the screw.

A wrench or crank handle is attached to one end of the shaft and the pattern is screwed through the stripping plate opening in the end of the corebox. An extension to the shaft at the opposite end supports the weight of the pattern until it is clear of the sand. The process is repeated until the required number of cores have been made.

After the cores have been dried they are placed end to end on the foundation and a wood wedge is driven between the end core and the upright end plate. A small riser core is placed over an opening at the high end, and the runner cup is built up to a corresponding height at the low end. The metal then is poured into the screw cavity which extends from end to end of the core assembly. In some instances auxiliary pieces of pattern are attached to the inside of one end of the corebox to form a clutch or other form of driving device.

Extreme flexibility is one of the main advantages of this method of molding conveyor screws. The method may be adapted to the production of combination right and left, screws, small and large flanges and intermittent flights on the same shaft. Naturally a separate pattern section and, in some instances, a separate corebox must be provided for each change in section.

Book Review

Practical Everyday Chemistry, edited by H. Bennett, cloth, 305 pages, published by the Chemical Publishing Co., New York, and supplied by THE FOUNDRY, Cleveland, for $2.00 and in Europe by the Penton Publishing Co. Ltd., London.

The author has endeavored to present a wide range of information on practical chemistry covering many articles which are in daily use. The text covers the following main headings: Adhesives, including cements; agricultural and garden specialties; coatings, protective and decorative; cosmetics and drugs; emulsions; food products, beverages and flavors; ink, carbon paper, crayons; leather; lubricants; materials of construction; paper; photography; plating; polishes; abrasives; rubber, plastics, waxes; soaps and cleaners; textiles and fibres; and miscellaneous. A conversion table of thermometer readings also is included. Information is presented on the analysis or methods of manufacture of several hundred different products.

Nonferrous Industry Code Authority Approved

Code authority of the nonferrous foundry industry has been approved by the NRA as follows: D. D. Francis, National Bronze & Aluminum Foundry Co., Cleveland, aluminum permanent mold castings division; H. A. White, National Metals Corp., Pittsburgh, steel and rolling mill castings division; H. E. Smeeth, Smeeth-Harwood Co., Chicago, blast furnace castings division; N. H. Schwenk, Cramp Brass & Iron Foundries Co., Philadelphia, miscellaneous sand castings division; N. K. B. Patch, Lumen Bearing Co., Buffalo, code authority chairman, and A. B. Norton, Aluminum Co. of America, Cleveland.

The miscellaneous sand casting division of the nonferrous foundry industry code authority also has been approved as follows: District 1, J. A Duncan, William Duncan Co., E. Boston, Mass.; district 2, C. E. Schley, Philadelphia Brass & Bronze Co., Philadelphia; district 3, T. S. Hemenway, Metal & Alloy Specialties Co., Buffalo; district 4, J. P. Jefferis, Shenango Penn Mold Co., Dover, O.; district 5, Vaughan Reid, City Pattern Works, Detroit; district 6, F. L. Hayes, Chicago Hardware Foundry Co., Chicago; district 7, George B. Miller, Leoffelholz Co., Milwaukee; district 8, Charles Wegelin, Dixie Bronze Co., Birmingham, Ala.; district 9, William L. Heckmann, National Art Bronze Works, St. Louis; district 10, M. S. Greenberg, M. Greenberg's Sons, San Francisco.

Production of alloyed gray iron in 1934 was equal to that of the peak year of 1929, according to a recent survey of the International Nickel Co., New York.

Varying Effects of Heat Treatment

	Tensile Strength, pounds per square inch	Yield Point, pounds per square inch	Elongation, per cent in 2 inches	Reduction in area, per cent
No. 1	115,000	76,000	23	30
No. 2	132,000	95,000	20	18
No. 3	137,400	123,950	12	10

Melting Conditions of Aluminum

(*Concluded from page* 23)

form of intercrystalline shrinkage crevices while in the commercial aluminum it was in the form of bubble-like cavities.

Saito and Hayashi—*Memoirs*, College of Engineers, Kyoto Imperial University, 1924, pages 165-178—found that a linear relation exists between length of spiral and pouring temperature of aluminum from 1260 to 1400 degrees Fahr. but obtained the same length of spiral at 1620 as at 1400 degrees Fahr. Their observations appear to be substantiated in more recent work by Saito and Matsukawa—*Memoirs*, 1932—on the viscosity of molten metals measured with a rotating cylinder. The linear relation extending from 1220 to 1470 degrees Fahr. found in the present work does not necessarily contradict the results of Saito and Hayashi since those authors did not investigate the region between 1400 and 1620 degrees Fahr. The present results, however, are in exact agreement with those of Courty—*Revue de Metallurgie*, 1931, pages 169-182—who finds that the linear relation holds from 1616 up to 1634 degrees Fahr.

The fact that the spirals obtained with the 8 per cent copper alloy were slightly longer than those obtained with the 99.2 per cent aluminum is also in agreement with the results of Courty who found that as copper was added to aluminum the lengths of the resulting spirals decreased up to about 2 per cent copper content and thereafter increased, the 7 per cent alloy, yielding about the same spiral length as the 99.3 per cent grade of aluminum, and the 8 per cent alloy yielding a slightly longer spiral. However, the conclusion which seems to be established, that pure aluminum yields longer spirals than the commercial grade, apparently contradicts the results of Losana—*Il Notiziario Chimico-Industriale*, 1927—who finds a greater fluidity for 98.32 per cent aluminum than for 99.26 per cent aluminum.

No satisfactory explanation is offered for the decrease in the length of the spirals resulting from superheating to 1560 degrees Fahr. Gas absorption by the molten aluminum during melting was suggested in the previous work as a possible explanation of this phenomenon. At the present time it generally is accepted that hydrogen is the gas most readily absorbed by molten aluminum. Methods of removing hydrogen from molten aluminum or aluminum alloys with chlorine, chlorine mixed with nitrogen, or chlorine compounds have been studied by a number of investigators. Lack of consistent improvement in running qualities from the zinc chloride treatment makes it doubtful that the superheating effect is due to absorption of hydrogen.

According to other investigators the running quality of aluminum may be affected by the presence of aluminum oxide. Treatment with oxygen produced little effect except in one case where the treatment resulted in distinctly shorter spirals. This leaves the explanation of the effect on the basis of aluminum oxide formation a probable one.

While no further work is planned at present, it is hoped that opportunity will be offered at some future time to carry this work to a more satisfactory conclusion.

Temperature of Metal

EFFECT of variables on the running quality of a metal is of considerable importance to foundrymen. This article is devoted to a study of two grades of aluminum, in which it was found that the relation between the length of spiral and the pouring temperature is linear. Publication of this article is approved by the director of the national bureau of standards, United States department of commerce. Mr. Krynitsky is associate metallurgist and Mr. Saeger is physicist of the bureau.

Green Sand For Steel Castings

(*Concluded from page* 25)

castings. The resulting mold will be refractory enough, permeable and hard enough to resist the action of manganese steel.

Many facings are not necessary for the various classes or divisions of work. A plan that has worked successfully is to prepare one green sand which need not be dried with the torch or with any heat, and another green sand facing for molds to be dried with a torch or charcoal fire. The second facing can be subdivided for two applications, one for the lighter castings and the second for heavy castings with thick metal sections.

A sand reclamation system comparatively inexpensive and adapted to the size of the foundry is necessary. Old cores, butts and used or burned sand can be converted to a source of new sand through the aid of the core crusher and the cleaning system. Sand from the cleaning room can be salvaged. Sand after being cleaned can be returned to the molding floor or to the core room. The average shop easily can operate on 200 pounds of new sand per ton of castings, and this figure also includes the core room.

Castings up to 15 tons can be made successfully in green sand. Jobs that required from two to three and a half days have been molded in green sand and the only difficulty encountered was a slight drying of the sand which interfered slightly with the finishing of the face. However, this is only a minor factor and eventually green sand molding will be recognized as the safest, fastest, most economical method for all classifications of steel castings.

Book Review

Alloys of Iron and Copper, by J. L. Gregg and B. N. Daniloff, 454 pages, published for the Engineering foundation by the McGraw-Hill Book Co., New York, and supplied by THE FOUNDRY, Cleveland, for $5.00 and in Europe by the Penton Publishing Co., Ltd. London.

This volume, the fourth of the Alloys of Iron Research Monographs series, presents the first comprehensive and complete summary and critical appraisal on available information concerning the alloys of iron and copper, and on the affect of copper on steel and cast iron. The monograph was prepared at the Battelle Memorial institute, Columbus, O., as a part of the institute's contribution to alloys of iron research. Previous publications include *Alloys of Iron and Molybdenum*, *Alloys of Iron and Silicon*, and *Alloys of Iron and Tungsten*.

A foundryman, metallurgist, superintendent, melter or engineer will find in this book a comprehensive discussion of the manufacture, properties and uses of steels and cast irons containing copper as an important alloy, including the important copper-bearing corrosion-resistant materials. For the scientist and research worker, the book presents the correlation of all research work on the binary iron-copper alloys and on ternary systems of iron, copper and a third element. Recent interesting developments in precipitation hardening of copper steels are reviewed and summarized.

The book also contains a discussion of the corrosion-resistant properties of low copper steel, and a comparison of the value of that steel with other low-cost corrosion-resistant materials. To prepare the manuscript, more than 1000 articles were located and nearly 650 were abstracted and studied. Reference is made to 400 of the more important articles in the text which appear in a selected bibliography at the end of the book.

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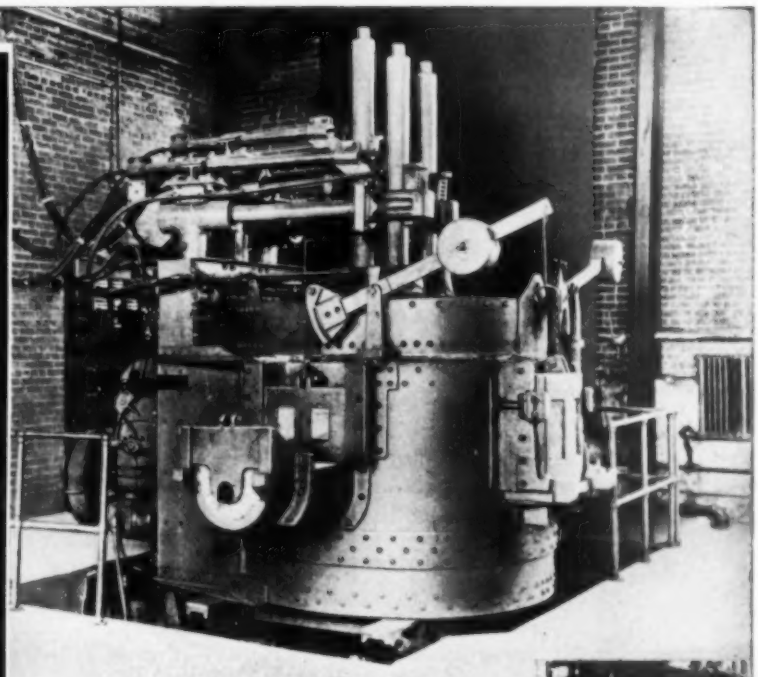

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Nitriding Iron Cast Centrifugally

(*Concluded from page 27*)

ing, the inside diameters are ground to size, thereby removing the nickel and providing a clean surface ready for nitriding.

Another process for selective nitriding consists in painting the surfaces to be kept soft with a special preparation made up as follows: 60 parts of powdered lead is mixed with 40 parts of powdered tin and 100 parts of this powder is mixed with 15 parts of the following: 5 parts of vegetable oil (corn oil or Wesson oil); 1 part of stearine (candle grease); 4 parts of lard; 2 parts of pulverized resin; and 1¼ parts of zinc chloride. To effect good mixing, the above should be heated slightly and stirred well. After the lead-tin and oil mixtures are combined and thoroughly mixed, the preparation is diluted with gasoline to give the proper consistency for applying a smooth thin layer with a soft brush or by spraying. Care must be exercised not to have any of the paint run into the surface not to be nitrided. Excess should be used for the same reason.

In the nitriding process, the nitrogen penetration reaches from 0.018 to 0.020-inch. Nitrided Nitricastiron has a surface hardness of 800 to 950 Firth diamond and 70 to 80 Rockwell superficial with a 30-kilogram load. Nitralloy steels develop surface hardness of 900 to 1100 Firth diamond and 85 superficial Rockwell. The hardness of the nitrided layer of iron is effective to a depth of approximately 0.006-inch beyond which it may still be very hard and effective, but measurement is impossible because of lack of support from the base metal.

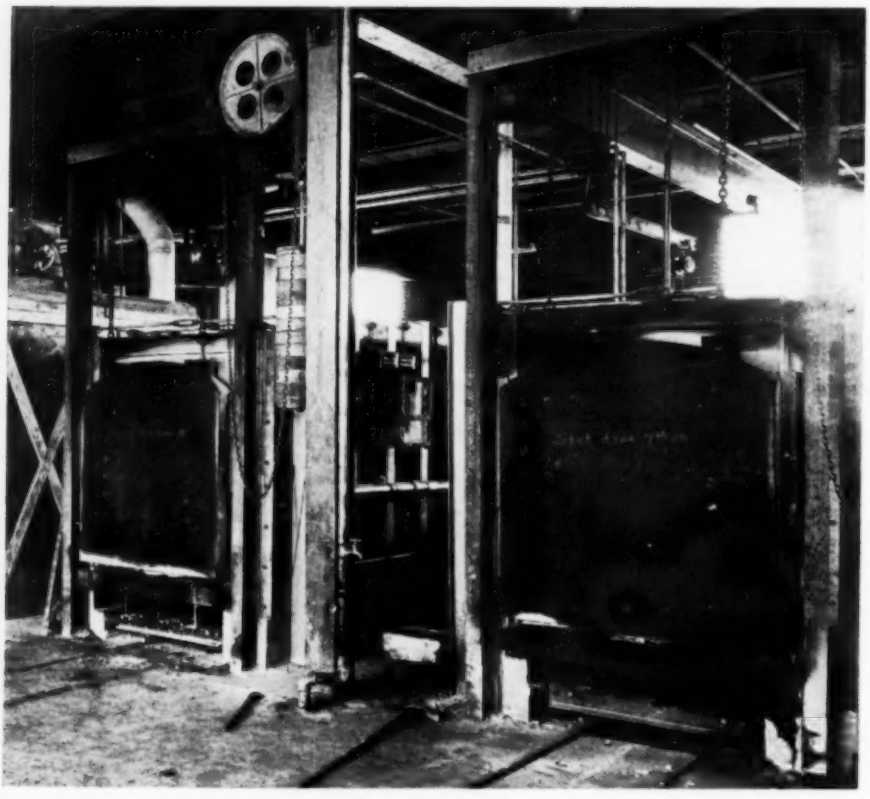

Fig. 3—Two oil-fired, car type furnaces in which the castings are heat treated

The outstanding application of the centrifugally cast tubes is for liners for internal combustion engines, such as bus and truck engines and diesel engines. The tubes are cast with an allowance for finish of ⅛-inch on the outside surfaces and from ⅛ to 5/32-inch on the inside surfaces, after which the raw castings are heat treated in the manner already described, are rough machined on the outside diameter, finish machined on the inside diameter to 0.002-inch, and cut to length.

Centrifugally cast nitrided tubes also are finding application for cylinders of pumps handling erosive material, such as slush pumps used in well drilling. Here the application is quite simple as the degree of accuracy which must be maintained for combustion engine cylinder sleeves is not needed. The cylinder walls for slush pumps when finished machined also are heavier, so that the machining operations are simplified considerably.

Cylinders 14 inches in diameter, 12 inches long, with 1-inch wall thickness have been centrifugally cast for the capstans of wire drawing mills. The outside diameters were finish machined to the desired dimensions and after nitriding gave very hard wear resisting surfaces on which the drawn wire could slip smoothly and continuously without the formation of grooves in the capstans.

Capacity of the centrifugal casting equipment in the Forging & Casting Corp. plant ranges from tubes of 1¾-inch diameter with ¼-inch as thinnest walls, to tubes 16 inches in diameter with ¾-inch as thinnest walls, and 36 inches long. With minor modifications, the equipment could be enlarged to extend the length of the larger tubes. Wall thickness on small diameter tubes should not be less than ¼-inch. Above 10-inch diameter a minimum of ⅝-inch thickness, and above 12 inches a minimum of ¾-inch wall thickness is necessary. The amount of finish for outside diameters should be at least ⅛-inch for small tubes ranging to 6-inch diameter; above 6 inches, the finish allowed should be correspondingly larger. For a tube 15 inches in diameter, at least 3/16-inch should be allowed. Minimum finish for inside diameters is ⅛-inch on a side; large tubes generally require a finish of 3/16-inch on a side which is sufficient to clean out the tube perfectly.

Connecticut Group Discusses Deoxidation

L. A. Ward, Chase Metal Works, Waterbury, Conn., addressed the regular meeting of the Connecticut Nonferrous Foundrymen's association, Feb. 19, on the subject "Deoxidation and Degasification of Cast Bronze and Brass". The meeting was held in New Haven, Conn., with David Tamor, president, presiding. An interesting round table discussion followed the presentation of the address. The next meeting is to be held at the Hotel Garde, New Haven, March 19 and will be addressed by Joseph T. Judge, Jenkins Bros. Co., Bridgeport, Conn., on "Nonmetallic Fluxes". The April meeting will be held at the plant of Bristol Co., Waterbury, and will deal with "Application of Pyrometry and Precision Instruments in Foundry Practices".

Thomas A. Wright, secretary, Lucius Pitkin Inc., New York, and president of the Buffalo Testing laboratories, recently was elected president of the Association of Consulting Chemists and Chemical Engineers.

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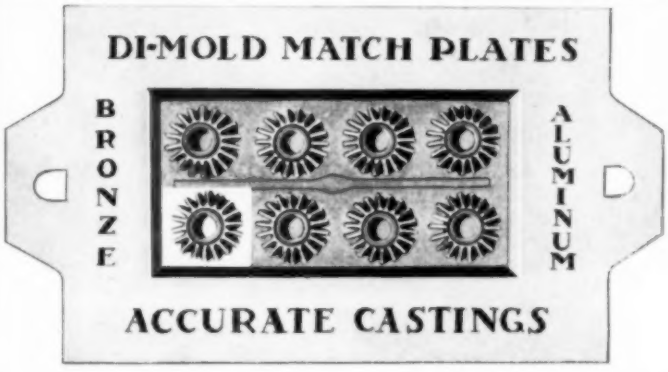

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By H. A. Schwartz

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Makes Remarkable Strides

(*Continued from page* 29)

and over until the accumulated slag lowered the fusing point of the bott to where it would melt into a heavy slag and start to run from the tap hole like taffy.

Coke was judged only by coking time, sulphur, and ash content. The importance of high or low fusion point, combustion speed, and so forth was not even anticipated.

Mixing metal by analysis was supposed to cure all ills. We knew the benefit of steel addition but beyond that we were pretty well at sea, especially in controlling machinability. Because of the high percentage of remelt, the foundries constantly were fighting high sulphur and were very much inclined to lay most of their troubles on that element.

Much of our trouble was blamed on the size of foundries we were trying to run, although a letting out of part of the castings to smaller foundries never seemed to improve the situation. As late as 1923 one of my superiors argued that we were on the wrong track with our big foundries. They should be broken up into a number of small units.

One of the retarding causes in building up an efficient organization was, and still is in many cases, due to the fact that where a foundry is operated in connection with a machine shop the upper management is machine shop trained. Since their foundry knowledge is limited they either ignore the foundry and treat it as a necessary evil or try to make a machine shop of it.

Casting Quality Has Improved

It would be interesting to follow the intermediate steps that have brought us up to our present practice. There have been many important changes but some have come so gradually that we are hardly conscious of them. Consider the quality of our present castings. We now are able to produce with certainty sand-castings within dimensional limits of 0.010-inch. We have learned to control the hardness, density, wear, machinability and strength so that a certain specified quality can be reproduced uniformly from day to day. In spite of all these additional demands, our losses are only a fraction of what they were, usually under 3 per cent in the foundry, and under 1 per cent in the machine shop.

It has not been easy always to meet the ever present demand for greater speed and greater durability which the engineer translates into specifications. Progress has been made speedier and easier through the co-operation of the designing engineer. In our organization the engineering department consults with the foundry as early as the rough layouts, not only on molding problems but on the possibilities of improved physical qualities of the material. This is important because if the design has gone through the experimental stage, a change for production may require a repetition of tests involving hundreds of hours. Even if the engineering personnel was willing to spend new effort, the time element, always the important factor, might not permit.

Cost is an important factor in producing an article that enjoys wide distribution, and it is ever present in the selection of methods and materials. For example, experiments with a new higher speed motor may prove that we have reached the limit with our flywheel iron. The quickest and easiest way would be to change to a steel or high test cast iron wheel, but initial and manufacturing costs block that easy way. The foundry, with the designer's help, meets the situation once more in regular practice by pushing the strength of cupola iron up another notch. Similar situations may arise suddenly with valve seats, tappets, pistons, etc.

Due to large volume, we may have in the automotive industry, a better appreciation of the savings involved from this co-operation. On a basis of a million castings a year, a saving on any one of the castings might save a quarter or a half million dollars. Even one cent saved on any one piece may amount to $10,000. We require approximately 60,000,000 cores a year. With only a fraction of a cent saved on part of these cores the saving would run into large amounts.

In our case the pattern shop is controlled entirely by the foundry. Patternmakers realize that the foundry is shipping only castings, and that a pattern is only a means to an end. To produce a perfectly dimensioned casting, the patternmaker may have to use two or three different shrinkages on the same patterns and core boxes, depending on the length, the wall thickness, the size and anchorage of the cores, and the metal to be used. To produce interchangeability under these circumstances involves careful planning, a good layout department, which is also responsible for all templets, and the best pattern shop equipment. Interpretations of blueprints by individual patternmakers is no longer practiced and therefore no blueprints reach the metal patternmakers. They receive their castings, templets, and instructions through the layout department composed of the best patternmakers. Responsibility of the method to be applied in production rests entirely with the production department.

Some years ago I wrote a paper on flask equipment, describing the rules we had developed in barring flasks to avoid the use of gaggers and nails. Those rules were worked out when we still required 40 to 50 jolts and the sand next to the pattern was loose on the bars. With the reduction of jolts from 50 to about 6, followed by a heavy squeeze that reaches clear to the pattern and sets the sand tight onto the bars, the clearance between pattern and bars has been increased to approximately ½-inch. This has eliminated the danger of soft spots under the bars and helped in shaking out. It also gives a little more leeway in building the flask. By barring the drags also, we have been able to eliminate all bottom boards which always were an unavoidable cause of scrap.

Success of this molding practice was furthered considerably by improvement in molding sand. To be able to take advantage of the additional speed it was almost necessary to eliminate venting of molds. This was accomplished through adoption of mechanical sand preparation and permeability control that assured a uniformly open sand that even a heavy squeeze could not close.

Foundry Uses Synthetic Sand

Up to 10 or 12 years ago we bought molding sand by known brands and according to number, with no particular specifications, and brought it long distances. Stricter casting specifications forced us into the use of milled sand which assured us greater uniformity. Higher casting temperatures forced us into milled and blended sand. Today our foundry uses a synthetic sand, mixed with fire clay according to fixed standards, with permeability, moisture and strength checked at given intervals during the day. There is as much importance attached to this check as there is to the checking of our iron.

This procedure was possible because we had learned of the various constituents that make up good molding sand. In this general we, I include everyone who has spent time and thought on this subject, especially the sand committee of the American Foundrymen's association. From the crude former way of conditioning sand, we now have arrived at elaborate sand conditioning equipment that receives the sand at the shakeout, prepares and delivers it where required. In most cases shovels only are used to clean sand away from around the machines. Where formerly we depended for sharp core sand on a source about 200 miles away we now are pumping it out of Saginaw Bay a few miles below our foundry at a cost of not over one-half of the former freight rate.

The story of the development of core oil would fill a book. We have arrived at a point where our cores are under perfect control. The oil is free working in core boxes, produces

(*Concluded on page* 67)

ADVERTISING PAGES REMOVED

(*Concluded from page 64*)

a minimum of gas, has resistance to high temperature sufficient to hold thin sections of core until iron is set, produces a strong surface on the big core, dries clear through the core before the outside is over-baked, bakes in reasonable time, destroys itself sufficiently in the casting to make core removal easy, and last but not least, it is of uniform quality reproduced from one shipment to another.

Blacking has developed from a mixture of plumbago to a specialized product.

Cupola coke has passed from the beehive to the by-product type, and instead of being judged by its sulphur and ash content it has to meet additional specifications on ignition point, burning speed, size, and strength.

Pig iron has become a greatly improved product, especially in its uniformity. Most or all pig irons can be considered good providing they are used in the right place. Those who have to produce iron to close specifications have learned that aside from close chemical composition, type represented by certain grades must also be followed.

Briquets Preferred to Scrap

Metal briquets have become common place and a valuable addition to our melting material, especially in the production of close-grained castings, composed to a large extent of close grained skins of castings, their effect in a cast iron mixture is somewhat like that of steel but with less chilling in thin sections and on corners. They are preferable to ordinary scrap.

Aside from the sandslinger and sand blower there has been no fundamental change in molding or molding core machines. However, there has been a constant improvement in construction, and an important shifting in the application of the jolt and squeeze operations that make the present-day molding machine a much more efficient unit.

Mold and casting conveyors have now become standard equipment and are being constantly improved and extended through additional operations such as knocking-out of cores and sandblasting.

There has been considerable advance in the cleaning of castings through mechanical core removal, handling of hot castings by conveyors, and continuous automatic sandblasting. Much has been done in foundry ventilation, but there is still a need for something better.

In the melting department we have removed most of the uncertainties of 20 years ago. Cupolas no longer are temperamental. Continuous melting through several shifts without fluctuation has become common-place. A plugged slag or tap hole has become a rarity. We are getting uniformly higher temperatures with better coke ratio. We have developed a considerable saving in lining material because we have learned to give the expanded gases in the melting zone enough room in the first place, instead of forcing a burning-out to the proper shape after the daily relining. The cupola charging problem has been solved through mechanical charging, and progress is still being made in more economical operation such as utilization of waste heat, etc.

Within the past few years there seems to be a swinging of first interest from mechanical equipment to the development of high strength cast irons, usually by duplexing in the electric furnace or converter. Our present economic condition, no doubt, is responsible for this shift. It is a development in the right direction although in many cases it means only a shift from one branch of industry to another.

A marked improvement may be noted in our plain cupola irons as compared with those of 20 years ago. In addition to the recognition of the importance of chemical compositions, the importance of the physical properties of the raw materials as a hereditary feature now is generally recognized. While we have as yet no scientific explanation of some of these hereditary peculiarities, at least we have established a practical working knowledge.

Aside from special high test iron used in crank and camshafts, all requirements of the automobile industry still can be met with cupola iron although higher motor speeds and higher compressions have been calling for stronger and more uniform iron with almost every change in models. To always meet the situation calls at times for considerable ingenuity.

The foregoing review of foundry progress in the past 20 years is confined to the automobile industry. Other branches, radiators, fittings, cast iron pipe by the centrifugal process, malleable foundries with continuous triplex and duplex melting process, and greatly shortened annealing cycle, steel foundries with greatly improved methods and products, can be credited with similar strides.

Book Review

Ores and Industry in South America, by H. Foster Bain and Thomas Thornton Read, cloth, 381 pages, published by Harper & Brothers, New York, and supplied by THE FOUNDRY, Cleveland, for $3.50 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

More and more people of this country are becoming interested in the future possibilities of the countries of South America with reference to industry and commerce. The question often is advanced as to whether or not South America can be expected to repeat the course of industrial growth and development which has been achieved in North America. The authors of this book are familiar with South America at first hand, one or the other having visited nearly every country. The book is an outgrowth of a series of conferences held by the Minerals group of the Council of Foreign Relations in 1931 and 1932.

The authors have discussed the general problems of the vast undeveloped resources in South America, studied the geography and geology of the continent, and dealt individually with various countries including Colombia, Venezuela and Trinidad, the Guianas, Brazil, Uruguay and Paraguay, Argentina, Chile, Peru, Bolivia, and Ecuador.

In conclusion it is thought that South America in the future will maintain the role of exporter of minerals. It is doubtful if any country there will be industrialized in the rapid way in which certain sections of North America developed. The chief reason is that both natural resources and the habits of the people favor making agriculture the dominant industry.

Pattern Storage Should Be Fireproof

Fireproof construction is one of the principal factors to be taken into consideration when planning a building designed for the storage of wood patterns. Temperature and moisture factors are secondary if not negligible, since they automatically adjust themselves in any well constructed building. Ordinary changes in temperature and humidity on the outside will not affect wood patterns stored under adequate cover.

Daylight is preferable to artificial light, if only for the reason that artificial light of any kind presents a certain degree of fire hazard. Also, all or practically all activities in the pattern storage building are conducted in the day time. Concrete, brick and stone are suitable materials for the walls. The choice for any given locality will hinge principally on the cost of the materials.

The typical modern pattern storage building includes a steel frame with concrete or tile walls surmounted by a tile, cement slab or slate roof. The concrete may be in the form of building blocks, or poured in a form. Steel racks and shelves on the inside suitably numbered according to the system in use in the plant, are erected for the storage of the patterns. To prevent the direct rays of the sun from falling on the patterns, the south wall is left blank, while the windows in the east and west wall are filled with frosted or wire glass. The north wall may have clear glass windows.

Field Museum Displays Cast Iron Bell

A large cast iron bell from the Lama temple in Tibet now is on exhibition among the oriental ethnological exhibits at the Field Museum of Natural History, Roosevelt road, and Lake Michigan, Chicago.

Recently reinstalled, this intricately ornamented bell hangs in a heavy wooden frame. Combined with the frame is a sounding apparatus consisting of a suspended heavy timber resembling a battering ram in design, with which the side of the bell could be struck. The bell, when it was in use, produced a note of pleasing tone and great volume.

This iron bell was cast in 1762 and hung for many years in a Tibetan temple. Illustration courtesy Field Museum News

This bell was cast in 1762 (the K'ien-lung period) by a Chinese artisan named Li Yen-ch'un. It weighs 196 pounds. For many years it hung in the Lama temple near Taochow, Kansu province. It was obtained for the museum by the Blackstone expedition to China and Tibet (1908-10), under the leadership of the late Dr. Berthold Laufer.

The bell is decorated with eight trigrams formerly used for purposes of divination; with chrysanthemum flowers, and with dragons playing with a pearl—symbol of an unattainable ideal. Two dragon heads joined together form the outside of the bearing upon which the bell swings on its axis. On three panels on the surface of the main part of the bell are, in high relief, the three stanzas of a Buddhist poem, in the Tibetan language.

Book Review

English - German Dictionary for Metallurgists, by Henry Freeman, fabrikoid, 347 pages, published by Otto Spamer Verlag, Leipzig, Germany, and supplied by THE FOUNDRY, Cleveland.

This volume, which is Part II of two volumes comprising the author's dictionary, lists English words with their German counterparts. It is arranged similarly to the German-English volume which was reviewed in the August 1934 issue of THE FOUNDRY, in that the first portion is devoted to various conversion factors which occupy 23 pages. That is followed by a list of the most current English and American symbols for quantities in equations, formulas, etc. The remainder of the pages is devoted to the vocabulary, and from a necessarily brief examination, it appears to contain a wide range of words that are common to the foundryman and metallurgist, but not often included in many of the available dictionaries. While it could be abridged in places, particularly with reference to chemical compounds whose German terminations are similar to the English, that does not detract greatly from the value of the dictionary.

Simplify Molding Of Steam Chest

(*Concluded from page* 31)

drag half of the mold.

Method of clamping cope and drag and of anchoring the chaplets is shown in Fig. 1 and more in detail in Fig. 4. The three bars *K* Fig. 1 rest on the cope immediately above the chaplets. The hook on the steel bar *R* engages the upper flange of the drag while the upper end projects through an opening near the end of the bar *K*. A steel key is driven through a slot in the clamp *R* to tighten the clamp. The screw *S* Fig. 4 then is tightened down on a flat steel strip resting on the chaplets.

Since the foregoing method was adopted practically all difficulties in the production of these castings have disappeared. The job is simplified to the extent that experienced molders are not required. Castings are straight, free from scabs, blowholes and porosity. Also they conform to the specified weight limit. Metal is poured into the mold through runner basins *B B* at both ends. The iron is poured as hot as it can be secured from the cupola. The 3000-pound charge in the cupola contains 600 pounds charcoal pig iron, 600 pounds steel scrap and the remainder return scrap. An addition of 1.00 per cent ferrochrome helps to combine the carbon and produce a bright surface on the casting after it is finished by grinding. The metal is close grained, will stand high steam pressure and has long wearing qualities. Typical analysis shows: Silicon 1.15 to 1.20 per cent; phosphorus 0.20 per cent or under; manganese 0.70 to 0.80 per cent; sulphur under 0.10 per cent.

Wins Safety Awards

American Brake Shoe & Foundry Co., Western Electric Co., and Youngstown Sheet & Tube Co. were included among the 14 firms named as winners of the Chicago safety council's 6 months' interplant accident prevention contest. Trophies will be awarded to these companies at a banquet in connection with the thirteenth annual midwest safety conference in Chicago, May 9.

George M. Pendergast & Co., 226 South First street, Milwaukee, has incorporated under the same name with capital of $40,000. George M. Pendergast is president and general manager.

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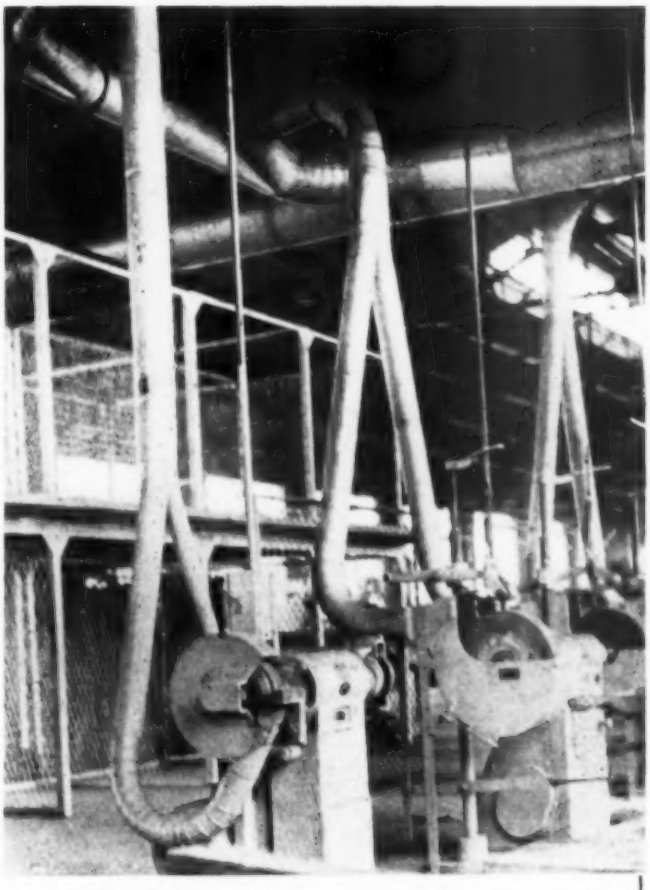

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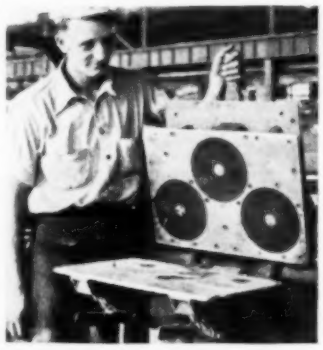

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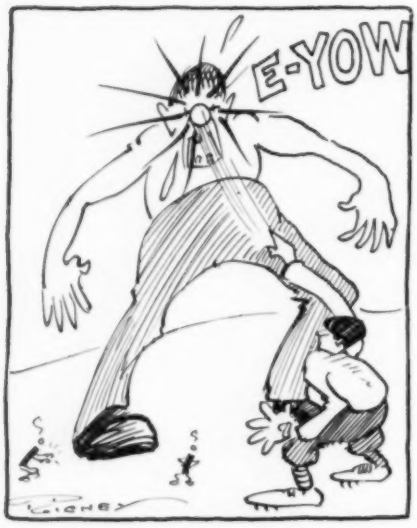


Extra! Goliath knocked out by a single high ball

The Adventures of Bill

BY PAT DWYER

"WHEN I was a young lad," said Bill, "which is another way of saying before I left home to—in the language of the time and place—seek my fortune, our house occasionally was favored by a visit from a widow woman who lived in the vicinity. She was a gabby kind of a dame, if you know what I mean, and would sit around for hours talking about nothing in particular. In those days women wore shawls over their heads and I remember—"

"Indeed! My good man. And how many did they wear?"

"How many what?"

"Shawls."

"What do you mean how many shawls? Did you ever see a woman wear more than one?"

"No," I said, "That is the point I wish to bring to your attention. You should strive for a little more accuracy in your presentation. First you refer to a widow woman when you know and I know, and—if I was minded to press the point—he, she and it know that every widow is a woman. I see no reason for using the two words when one is sufficient. The fact that you refer to a person as a widow naturally carries the implication that she is a woman. You would not say a maiden woman or a wife woman or a mother woman, so why the useless widow woman. Furthermore—"

"Furthermore you are talking like a weasel or two pigs under a gate. What has all this to do with a woman wearing a shawl?"

"Quiet, please. I am coming to that. Don't let your angry passions rise. Count ten. Remember the fable of the little birds in the nest. One of 'em stretched his neck too far and fell out."

"Some day," Bill remarked darkly "some day, you mark my words, some day, a certain party, not mentioning no names, will get his neck stretched and tied in a true lover's knot. 'Tis true I am slightly out of practice at the moment and might have to do a little preliminary work with a granny or a half hitch, but what's a little time more or less when one is engaged in a labor of love?"

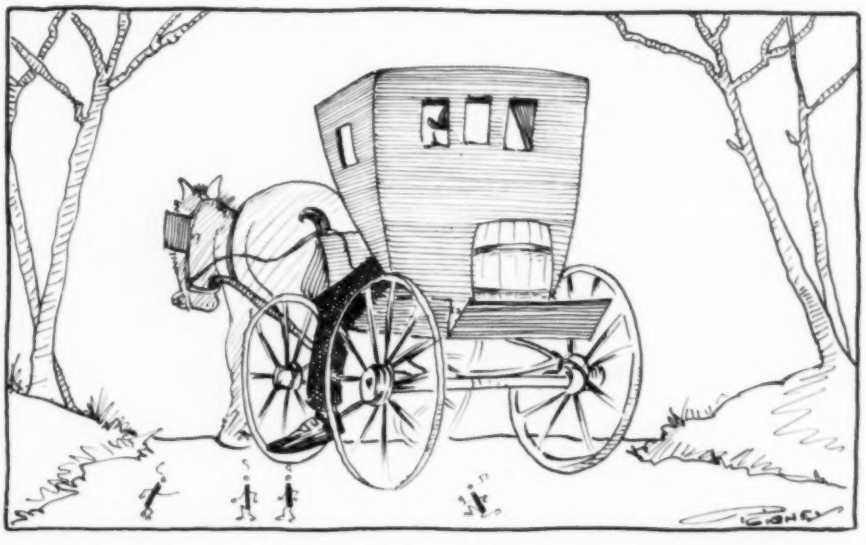
"Just so," I said, "Your esteemed favor of recent date safely to hand and contents noted. In reply beg to advise Who's afraid of the big bad wolf?

"Referring to a wolf, either in his own or in sheep's clothing, naturally suggests a fur coat and a fur coat in turn merely is a substitute for a shawl and that brings us back by a slightly circuitous route to your gabby widow woman swathed in shawls like a cocoon or a head of cabbage."

"All right," said Bill, wearily, "The widow woman is a wolf in sheep's clothing, the shawl is a cocoon and you are a head of cabbage. So what? Where does that leave me?"

"At the post, my boy, at the post of accuracy. You said that women wore shawls over their heads, thereby conveying the impression that every woman carried a stack of shawls on her head after the manner of a juggler who balances a pyramid of flower pots or bushel baskets in the same position. Now, if you had said that each woman wore a shawl over her head, just one single, solitary shawl—"

"Oh, yeah? If I had said each woman wore a shawl over her head you would be just nosy enough to inquire if she wore it over her head like one of these halos or like the canopy over a surrey with the fringe hanging down all around. Assuming that your limited intelligence could absorb a reasonable explanation on this point, I am positively certain you would break out in another quarter. Because I merely mentioned the shawl over the head you would accuse me of implying that this was the only garment worn. As dumb as you undoubtedly were in your young days, you must have noticed that the volume of clothing worn by one woman would equal the



Early car model showing knee action among the wheels

amount worn by at least six women today. When you took Mary Anne out for a spin in the livery stable top buggy, you sat squashed in one corner of the seat with your right foot dangling outside covered with dust or mud and in imminent danger of being nipped off between the wheels while going around a turn in the road. Road accidents happened occasionally in those days, but you never heard of the woman getting hurt. The man might crumple up like a busted concertina, but the woman was as immune to bumps and falls as one of the old time bed ticks stuffed with straw. Even if she fell on her head the shock was absorbed by a hat and a mass of hair, natural and artificial, as big as a crow's nest. Clothes! A little woman five feet, two inches in a pair of high heel shoes and weighing—of course this is just a vague guess—weighing 98 pounds in a bath tub, would take up more room in a street car than 2½ policemen."

"Your acquaintance with policemen apparently is more extensive than mine. So far as personal experience and memory serve, this is the first reference I ever have heard to a half dick. Perhaps it is a new species recently developed to cope with infant prodigies?"

"Boy," said Bill, admiringly, "that's an idea! Turn the beagles loose on 'em, eh? Shows that the tares springing up among the wheat have not altogether blinded your left hand from seeing what your right hand is saying. However, on this half dick proposition. What I meant is half lit. Whenever you see three of these birds together one is bound to be half lit and as gabby as this here now widow woman I started to tell you about."

"Have it your own way. I have done my best with chart and compass to hold you on a true course. If you insist on following shawled widows, cabbage heads and fractional policemen, don't blame me if you run her ashore."

"Leave 'er to me. We'll all roll down to Rio together. You and me and our mutual friend of the salty deep good old Reuben Ranzo! Ever hear of Reuben?"

"No," I said, "and if he is like the rest of your friends, I don't want to hear any more about him. Stick to the widow and get going. Apparently she either was an exceptionally good teacher, or — a rather far fetched conclusion—you had occasional gleams of intelligence in your youth. Certainly if, as you say, she was a gabby kind of a dame, she succeeded in inoculating you with the virus thoroughly and completely."

"Well," Bill modestly admitted, "I generally can find enough words in the old grab bag to convey my meaning. Provided of course," here he paused for a moment, "provided of course, the party of the second

Yes Ma'am, men certainly are quare

part is willing to listen and is endowed with a grade of intelligence slightly higher than that displayed by our dear little furred and feathered friends. I would include fish in the category, but the word in recent years has become so intimately associated with an entire absence of I.Q. rating that I hesitate to employ it in present company. Fish is out.

"What I am leading up to—"

"Leading up to is good. Leave word with the porter to call me when you arrive."

"What I am leading up to," Bill continued ignoring the interruption, "is a pet expression this widow woman had in commenting on peculiar habits, customs, acts or beliefs of individuals or classes of people. Any thing that did not meet with her approval she dismissed with, 'Well, all I can say is that people are quare.' F'rinstance, the subject of giants came up one day. Up to that time I had firmly believed in the authenticity of these gents, but my faith was jolted when I heard **her** calmly announce that 'some people certainly were quare if they believed in such nonsense.' "

"If you ask my opinion," I said, "I think your widow woman with the shawl over her head was quare. Everyone knows there were giants in those days. Not only in the days of the old bearded prophets, and before, but in comparatively recent years, for example when Lumber, bearded with moss and in garments green was King in Michigan. When burly lumberjacks with little felt hats turned up at the back like a duck's tail and cocked belligerently over one eye, swaggered through the streets of Saginaw, Bay City and every other river town and practically ruined the plank side walks with the calks in their shoes.

"They drank their liquor raw, likewise free and frequent. They danced and fought with homeric abandon, and they told tall tales of Paul Bunyan and his blue ox Babe—so help me—four axe handles and a plug of tobacco across the forehead, and packing an appetite that sucked up food and drink as a forest fire consumes miles of standing timber.

"The blazed trail and the forest runner are but a memory in the upper and lower peninsula. The ramping, stamping burlers and bully boys with the spiked shoes on their competent feet and the cant hooks and peavies in their capable and hairy hands, all, all have roared out their last rollicking chorus and with the leaves of the forest have faded away.

"Paul Bunyan and the sturdy Babe have joined the ranks of the immortals in the world's hall of fame beside Hercules, the Goban Sair, Goliath of Gath, Gog and Magog, Jack o' the Beanstalk and the Ram o' Darby. Fortunately the race never dies out. Other giants have arisen from time to time to take the places of those who have been gathered to their fathers. Giants? Of course there were giants. Always were and always will be. And what do you know about that?"

"Well," said Bill, "I'll tell you. I know where the widow woman would classify you if she heard you. In strict confidence between old friends and with the understanding that I don't care where you repeat it, I don't mind telling you that my opinion is exactly the same as the widow woman's. Some people are quare—well, er,—quare. In deference to the widow woman's memory I shall not add the proper qualifying adjective which comes in front of quare, but with your foundry training, you probably can hit it inside three guesses.

"As a patriotic American citizen, and with certain mental reservations I am willing to concede Paul Bunyan and the Babe, but where does this here now Herr Kyulees come in? He may have been quite a guy in his time, but with a name like that, what chance would he have in modern Germany? 'Fi-fo-fum-sneeze', says Herr Hitler through his funny moustache, 'I smell the tracks of Herr Kyulees' and, zip, just like that, Kyu hops into a pair of well greased seven league boots and before you can say dunder and blitzen he is over the border like a double articulated, compound, mallet type jack rabbit flying from a prairie fire.

"I have heard my father—God rest him—A great stickler for the truth—I have heard my father speak with great respect of the Goban Sair, the

greatest mason and stone cutter ever known in Ireland. A right merry lad, the Goban. In beggar guise he would appear before the boss stone cutter and ask for a job, and be promptly refused. He would return by moonlight, whack out a masterpiece, the equivalent of four ordinary men's work for a week, hoist it into place and disappear.

"I would not like to say a word against the Goban, but as for giants in general, well, any person who believes in that kind of moonshine is quare. Stick a pin in any of 'em and what have you got? Deflated toy balloons. How do I know? Har, har! How do I know? Just run over in your mind all the giants who snorted through their nostrils and cried 'Fee-fi-fo-fum' in Washington during the past three years. Giants are the product of the imagination of quare people, and unfortunately and apparently the quare people are as numerous today as they were in the days when my wise old friend the widow woman summed up the situation in the phrase, 'People are quare.' "

Pulley Pattern Cut on the Band Saw

All the parts for the double flange pulley pattern shown in the accompanying illustration were cut and shaped on the band saw, quite contrary to orthodox teaching and to all good rules and standards governing patternmaking practice. The pattern was made as a unit with the exception of one ring—the upper flange ring in the illustration—which was fitted with nail dowel pins. In the mold the position of the pattern was reversed. The loose ring occupied space in the drag, while the remainder of the pattern was molded in the cheek. The entire mold was made in a three-part flask. Strange as it may seem, the casting made from this crude pattern was equal in every respect to those made from patterns constructed and finished with the most minute attention to detail.

For easy reference the various parts are marked in Figs. 1 and 2. Thus *A* is the loose flange, *B* is the hub, *C* is one half of the rim ring, *D* is the web center, *E* is the second half of the rim ring and *G* is the flange attached permanently to the rim. The loose flange *A* was made from two courses, each containing six segments. The hubs *B* were cut from glued stock. The lower flange ring *G* was made from six single segments. In assembling flange *A* an open end point was left in the lower course of segments while the corresponding straddling segment was left loose. The saw was passed through the open joint and the inside of the segments were cut to the proper circle. The saw then was removed and the loose joints glued. The lower ring *G* was handled in a similar manner.

The rim rings *C* and *E* were alike, made up of six segments each 3⅝-inches deep. The inside of the ring was sawed by tilting the table to the required bevel, and passing the saw

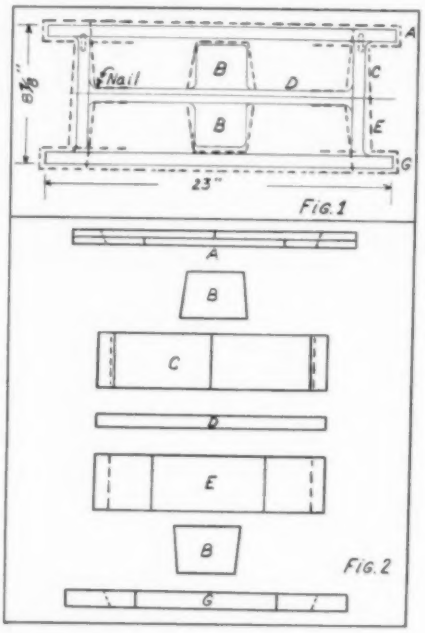


Fig. 1—Double flange pulley pattern.
Fig. 2—Various parts of the pattern

through an open joint. The sawing was done with a ¼-inch saw, 6-point, medium set and sharp and running true on the wheel.

The ring was fitted to a circle scribed on the face of the web. Four brads were driven at approximately equal distances around the circle and close to the ring to serve as guides. The ring then was removed, glue was applied and the ring returned to place. The operation was repeated for the second ring *E* and all three parts, the web and the two rings, were clamped and set away to dry. The saw table was set to a slight angle and the outside of the ring was sawed and given the required amount of draft at the same time.

The flanges *A* and *G* were sawed, inside and out, to the required diameters. Flange *A* was fitted to the ring with wire nails for dowel pins. On a pattern to be used frequently, the flange would have been fitted with a turned male and female guide, but for a one-off casting the nails served adequately. The ring *G* was nailed and glued securely in place. The solid hubs excessively drafted, also were nailed in place. The ends of the rings *C* and *E* adjoining the saw cuts, were glued and further secured by corrugated fasteners dipped in thick shellac and then driven into place.

Pittsburgh Group Holds Joint Meeting

Pittsburgh Foundrymen's association moved up their February annual meeting from the originally intended time of Feb. 18 to Friday, Feb. 15, to conduct a joint meeting with the Pittsburgh chapter of the American Society for Metals at the Keystone Athletic club, Pittsburgh.

After an informal dinner, Dr. J. T. MacKenzie, metallurgist of the American Cast Iron Pipe Co., Birmingham, Ala., spoke on, "The Influence of Graphite on the Engineering Properties of Cast Iron."

Dr. MacKenzie discussed the effects of composition and manufacturing practices on the form and distribution of graphite in cast iron, as well as the influence which these in turn exert upon strength, machinability, wear resistance and other properties. Following the address, Jerome Strauss conducted a discussion.

Book Review

A. S. T. M. Tentative Standards 1934, 1257 pages, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland, for $7.00 in paper binding and $8.00 in cloth plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., London.

This publication, which is issued annually, is the only volume containing all of the A. S. T. M. tentative specifications, methods of tests and definitions of terms covering engineering materials and the allied testing field. These tentative standards, issued as proposed standards, and embodying the latest thoughts and practices in the various fields represented, find important applications throughout industry. A number of the tentative standards are of interest to producers and consumers of castings.

The 1934 edition contains 236 tentative standards, of which 48 are included for the first time, and 60 were revised during 1934. Classification includes 25 tentative standards on ferrous metals, 25 on nonferrous metals, and several on other products related in some way to the iron and steel industry.

New tentative specifications published, include the following ferrous and nonferrous materials: Alloy-steel castings for valves, flanges and fittings for service at temperatures from 750 to 1100 degrees Fahr.; magnesium-base alloy ingot for remelting, and magnesium-base alloy die castings.

A subject index has been included listing items under the materials and subjects to which they apply.

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SMOOTH-ON

Use Plaster for Foundry Patterns

(*Concluded from page* 33)

pattern. Even though the art of electroplating is comparatively old the practitioners still have little vest pocket secrets. Where the amount of work may warrant the installation of a plating outfit, the patternmaker may do the work in his own shop. However, the practice is tricky and usually he will receive more satisfactory service by entrusting his work to those who conduct professional establishments of this character.

In this connection it is pertinent to direct attention to a few don'ts which must be observed in the process of applying a metal coating to plaster patterns. Don't forget to insert small pieces of copper tubing to form draw and rapping holes in the pattern. Don't forget to dry the pattern thoroughly before it is placed in the wax bath. Moisture in the plaster will cause the hot wax to spatter and fly and may burn the operator. Don't fail to finish the surface perfectly before it is plated. Preferably the metallic coating should not be fingered before the pattern is placed in the electrochemical bath. In the event that the patternmaker is not familiar with a suitable metallic coating or does not know how it may be applied, he can send the wax soaked pattern to the electrotyper's establishment. The plater will prepare the pattern to receive the metallic deposit.

Patterns Have Long Life

A plated pattern cannot be compared to iron, but in the main it is equal to a white metal pattern. Dents and bruises readily may be filled with solder and filed smooth. A typical pattern for a motor head has been used to make 2800 castings. With the exception of a few minor repairs to dents caused by carelessness in the pattern storage, the pattern is as good as a new one.

Any person dealing with patterns readily will appreciate the extent to which a pattern is strengthened by enclosing it in a copper sheath from 0.010 to 0.015-inch in thickness. Thin wood master patterns also might be treated in this manner to prevent them from breaking or warping. Incidentally a prominent firm in Detroit is engaged extensively in the production of patterns according to this method.

Large bronze statuary figures either single or forming part of a group are made according to either one of two methods. In one a thickness of wax is employed to represent the pattern. It is enclosed between the inner and outer walls of the mold during the construction period and is melted out after the mold is completed and while it is drying. Metal then is poured into the cavity left by the wax and naturally it duplicates every feature including the thickness. This is known as the *cire perdu* or lost wax process.

In the second method a plaster pattern is prepared and the mold is made in sand in an iron or steel flask. With the exception of several features connected with drawbacks and the core, the method pursued in making the mold does not differ from that practiced in the ordinary jobbing foundry in the production of castings of the same general size and shape. A two-part flask is employed. It is rolled over. The cope is lifted off. The pattern is removed. The core is set. The flask is closed and the metal is poured into the mold.

However, much preliminary work is required before the pattern is delivered to the foundry. Up to a certain point this preliminary work is the same whether the casting is to be made according to one or the other of the two methods indicated. The following description applies to the second method.

Having decided on a definite design for the proposed casting the sculptor prepares a perspective sketch to illustrate what he has in mind. With the sketch for a guide he fashions a clay model about 12 inches in height in which every feature of the finished figure is worked out accurately in detail. The clay model then is set up on a suitable stand where the sculptor constantly refers to it for verification in constructing a full size duplicate also in clay.

Builds Plaster Casing

A plaster casing is built up around the clay figure to form a mold for the plaster pattern which goes to the foundry. This casing corresponds to the loam wall which a molder builds on the outside of a pattern in ordinary foundry practice. A thin coating of plaster tinted blue for a purpose to be explained later, is painted on the clay figure. This is followed by thicker plaster poured into suitable rough wood forms built up around the clay figure in successive tiers until the figure is completely enclosed. The wall is parted by thin strips of metal at a few convenient points to facilitate the removal of the clay and later the appplication of the plaster to form the pattern.

The plaster mold is taken apart. The clay is removed and then after the inside surface has been thoroughly cleaned and oiled the mold is reassembled several sections at a time for the convenience of the man applying the plaster for the pattern. The plaster is applied by throwing it against the face of the mold in handfuls in the same manner that a molder applies loam to the face of the brick work on a loam mold. It is apparent that if the plaster mold is assembled in its entirety at first an extremely difficult problem would be presented in the application of the plaster. With a mold in several sections the plaster easily is applied to one part at a time until the entire face of the mold is covered with approximately 1-inch thickness of plaster.

Usually since only one casting is required and since the pattern itself never will be used again except possibly for exhibition purposes, no particular care is exercised afterward in the removal of the plaster mold from the outside. It may be noted in passing that up to this point the two methods referred to for making the pattern are fairly parallel. At this stage of the process, they separate. For example the plaster mold employed in the *lost wax* process carefully is built up in jointed sections that may be removed and reassembled many times for the production of as many wax patterns as may be required, as in ordinary practice.

In the method under consideration the rough outside plaster mold is knocked away with a hammer and chisel. When the chipper notes the blue tint on the plaster he knows that he has arrived close to the face of the plaster pattern. He proceeds cautiously thereafter. All minor ridges and imperfections on the surface are removed and after the sculptor has satisfied himself that the pattern conforms to his conception he turns it over to the foundry. Usually it is divided into sections for convenience in molding.

This is the fifth and concluding article in a series dealing with the use of plaster as a foundry pattern material.

THE EDITORS.

Discusses Sands

A recent issue of *Sands, Clays and Minerals*, a publication devoted to economic minerals published by A. L. Curtis, Westmoor laboratory, Chatteris, England, contains several articles of interest to the foundry industry including "Molybdenum and Its Uses," by L. Sanderson; "Bentonite," by J. N. Wilson; "Limestone," by F. J. North; and "Refractory Cement for High, Medium and Low Temperatures," by W. O. Lake.

Philadelphia Joint Meeting Discusses Iron

Dr. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., spoke before a joint meeting of the Philadelphia chapter of the American Society for Metals and the Philadelphia Foundrymens' association on Feb. 22 at the Engineers club, on "Modern Cast Iron".

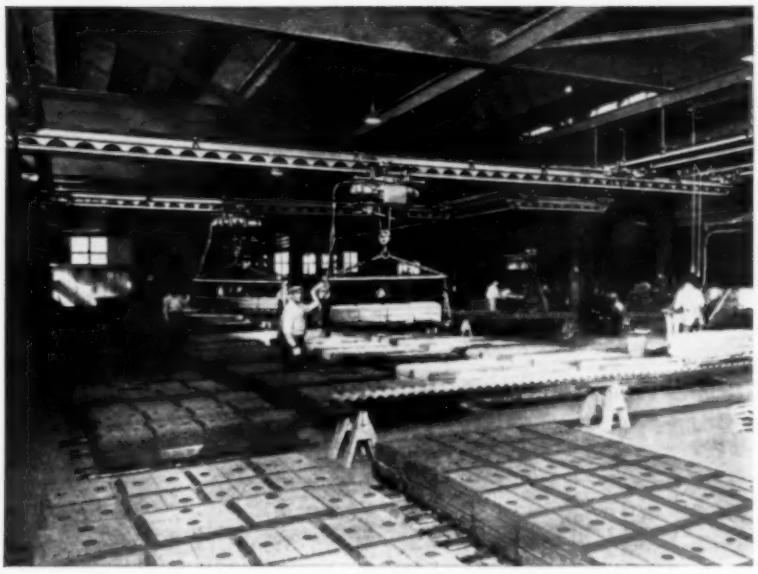

Photo 2078 — Molds being placed by hand propelled interlocking transfer bridge and push button controlled hoist.

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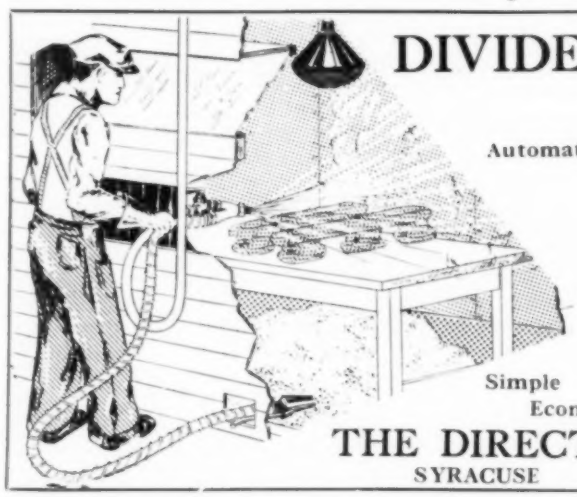

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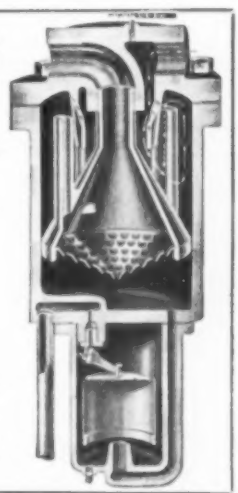

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Plan Short Course And Sectional Meeting

A foundry short course and sectional meeting, sponsored jointly by the Michigan State college, the Detroit Foundrymen's association, and the American Foundrymen's association, will be held on the campus of Michigan State college, East Lansing, Mich., May 9, 10 and 11. Sessions will be devoted to a symposium on "High Test Iron," with special emphasis on the future of cast iron founding.

Subjects which will be discussed are as follows: "Fundamental Aspects of High Test Cast Iron as Shown by Iron-Carbon Diagram"; "Superheating Gray Iron"; "Heat Treatment of Cast Iron"; "Alloys and High Test Cast Iron"; "Practical Aspects of Founding High Test Cast Iron with Particular Regard to Gating and Sand Control"; "X-Ray Inspection"; "Spectroscopy as a Control Medium in Cast Iron Foundries"; "Mechanics of High Test Cast Iron"; and "The Foundry of 1950."

The general committee arranging the program is as follows: Fred Erb, Eaton-Erb Foundry Co., Detroit; Jesse D. Stoddard, Detroit Testing Laboratory, representing the American Foundrymen's association; Vaughan Reid, City Pattern Works, Detroit; and Glenn Cooley, Detroit Edison Co., Detroit, representing the Detroit Foundrymen's association. Frederick G. Sefing and M. F. Surls represent Michigan State college.

Book Review

Keeping Young In Business, by E. B. Weiss, and Louis L. Snyder, cloth, 172 pages, published by Whittlesey House, McGraw-Hill Book Co., New York, and supplied by THE FOUNDRY, Cleveland, for $1.75.

Of the numerous inspirational type books written during the past few years with the idea of making it possible for the reader to improve his opportunities, this small book should hold more than average interest. The authors have discussed in an interesting manner the important subject of getting along with a job without letting the job get the better of the encounter. They have endeavored to determine how the most successful business men approach the vital problem of keeping young in business.

The authors warn against this age-old habit of getting into ruts in business, discuss the need of the individual worker bossing the job rather than having the job boss him, point to wasted business hours, suggest the need for watching the clock in an effort to utilize the time to the best advantage, stress the necessity for balancing work with the proper leisure activities, emphasize the need for keeping the mind and body active, and discuss other topics.

A special chapter is devoted to the importance of studying the business publications in the particular field and a need of keeping abreast with the progress of the industry.

Chicago Section Of A.F.A. Stages Party

Nearly four hundred persons attended the annual Ladies' Night party of the Chicago section of the American Foundrymen's association, held at the Swedish club, Chicago, Feb. 15. Dinner preceded dancing and cards. T. J. Magnuson, Champion Foundry & Machine Co., Chicago, was general chairman of arrangements.

Large Steel Casting For Hydraulic Riveter

The open hearth steel casting shown in the accompanying illustration is a head stake for a hydraulic riveter recently made to the order of the American Locomotive Co., at the Standard Steel Works Co., plant, Burnham, Pa., a subsidiary of the Baldwin-Southwark Corp., Philadelphia. The casting is 6 feet 6 inches in depth, 9 feet 6 inches in width and 32 feet 3 inches in length. The shipping weight is 103,720 pounds. Chemical analysis of the metal showed: Carbon 0.28 per cent, silicon 0.35 per cent, phosphorus 0.033 per cent, manganese 0.75 per cent, sulphur 0.035 per cent. Physical properties of the metal showed: Yield point 45,000 pounds, tensile strength 73,500 pounds, elongation 25.5 per cent, reduction in area 40.5 per cent.

Aluminum Casting Problems Are Discussed

British Aluminum Co. Ltd., 30 Rockefeller Plaza, New York, recently has published a booklet on "Aluminum Alloy Castings". Sections of the booklet discusses aluminum casting alloys, the selection of alloys, mixing aluminum alloys, melting practice for aluminum alloys, metal handling, pouring, molding practice for sand castings, permanent mold casting practice and heat treatment of aluminum alloy castings.

Coke Production Discussed at Freeport

The regular meeting of the Illinois Foundrymen's association, held Feb. 12 at the Hotel Freeport, Freeport, Ill., was addressed by Mr. Mulcahy, chief chemist, Terre Haute By-Product Coke Co. The speaker gave a brief statement on the geological history of coal, and then described the coke obtained from different coals. He pointed out that to obtain coke having as many desirable qualities as possible, blending of coal is practiced. Mr. Mulcahy then described methods of pulverizing, charging, and coking. An interesting discussion followed the address.

To Handle Sand Screens

H. M. Davison Co., 194 Frelinghuysen avenue, Newark, N. J. and 30 Church street, New York, has been made sales agent for the Simplicity Engineering Co., Durand, Mich. in Connecticut, southeastern portions of New York, the northern half of New Jersey and metropolitan New York.

The large casting weighed 103,720 pounds when shipped. Metal was melted in the open-hearth furnace

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European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Cupola Blowers

Blowers for Cupola Operations (Ventilateurs de Cubilot), by Roger Agrafel. *La Fonte*, Paris, September, 1934.

A general description of centrifugal blowers is given. The characteristics of a blower are: Volume of air blown; pressure; speed of rotation; power absorbed; specific weight of the air. The pressure at the outlet is determined by the pressure required in the wind belt of the cupola, account being taken of losses occurring between the blower and the cupola. It is stated that the pressure in the wind belt is proportional to the square of the volume of air delivered.

A brief outline is given of the theory of blowers with constant speed, and blowers delivering a constant volume of air. In his conclusion, the author emphasizes the necessity of calculating accurately the factors governing the installation of a blower, and the importance of having an instrument that measures the delivery of air. A well-conceived blower contributes largely to the satisfactory operation of a cupola, with resulting economies.

Copper in Cast Iron

The Influence of Copper on Gray Iron (Ueber den Einfluss von Kupfer auf Grauguss), by E. Soehnchen and E. Piwowarsky, *Die Giesserei*, Duesseldorf, Germany, Oct. 26, 1934.

Copper additions from 0.5 to 2 per cent, according to the authors, give an improvement in strength, wear resistance, and volume stability. The wall-thickness sensitivity as well as the graphite size and quantity are not influenced. Researches on the physical properties strengthened the conception that at the most from 0.5 to 1 per cent copper is soluble in gray iron, but above that the alloy separates in the form of globules. Coercive force, remanance, and coefficient of expansion are increased, thermal and electrical conductivity are lowered around about 1 per cent copper; above that they again increase. Corrosion resistance to acetic acid increased while in other mediums copper exerted no inuence. The unfavorable influence of the graphite on corrosion procedure was confiermed anew.

Aluminum Bronze

Aluminum-Bronze Castings and Quality-Control Methods, (Moulage du Bronze d'Aluminum et Methode de Controle de la Qualite) by Ch. Meigh. *Bulletin* de l'Association Technique de Fonderie, Paris, May, 1934.

Most specifications (in France) stipulate that aluminum-bronze castings should be cast either in metallic or in sand molds. This prevents the founder from using the method of casting that will bring out the maximum quality in the casting. Aluminum-bronze castings can be poured in metallic molds, or in ordinary sand molds, or in sand molds with chills.

Dealing with the use of chills, it is stated that there are three principal cases in which they can be used profitably: (a) to obtain a casting te shape of which would otherwise make it impossible of feeding; (b) to increase the strength of the metal at certain determined points; (c) to reduce production costs by using a semipermanent mold.

With regard to the aptitude of a casting to be chilled, this, up to a point, is less as the mass of the casting decreases, and beyond a certain mass, the aptitude to chilling remains constant at a certain minimum, irrespective of the conditions of the mold. In that case the composition of the alloy alone can modify the qualities of the metal.

It is essential, therefore, that the designer of an aluminum-bronze casting should co-operate with the founder to arrive at the best method of casting to obtain the characteristics required by the designer in the various parts. The author suggests various ways in which such co-operation can be established.

In addition to the micrographic examination, it is recommended that a test-piece should be cast in a standard mold to give the measure of tensile strength and, more particularly, of elongation. The use of a test-piece cast on the casting is not recommended in the case of aluminum-bronze castings, owing to the tendency of this alloy to give rise to considerable piping.

Ingot Molds

Manufacture of Ingot Molds (Fabrication des Lingotieres d'Acierie), by J. Leonard. *La Fonderie Belge*, Liege, October, 1934.

Ingot molds are divided into two classes, namely, those that are symmetrical, and those in which one dimension is markedly longer than the other (rectangular). Molds belonging to the first class wear through corrosion of the internal walls.

Ingot molds of a rectangular section perish through fissuration, owing to repeated strains through cooling and heating. Therefore, in casting such molds it is essential to take all necessary precautions to avoid internal stresses. Such molds should be cast with iron at a relatively low temperature, and the iron should be poured slowly through a top gate. The ingot mold should be taken out of its mold quickly and allowed to cool slowly without any effort being exerted upon it. A Belgian foundry obtains good results by cooling its ingot molds in pits in which cold air is circulated. The life of ingot molds can be lengthened substantially if the steelworks operator uses such molds with a certain number of important precautions.

With reference to corrosion of the internal walls of ingot molds, the study of growth is interesting. Reference is made to investigations made on this subject by A. Le Thomas, with the Chevenard dilatometer. The author develops the results of these experiments and points out that they tend to show that the iron to be used for ingot molds should have a low content of manganese (0.4 to 0.5), a silicon content of about 1.2 per cent, and a toal carbon content ranging from 3.6 to 3.7. The iron should be ferritic; therefore, cooling should be slow and the pouring temperature on the low side. The molds should be warm before the iron is poured. The detrimental influence of an oxidized iron is brought out, and a suggested composition for the mixture is: 15 per cent iron containing vanadium and titanium additions, 35 per cent hematite iron, and 50 per cent scrap or rejected ingot molds.

Obituary

ARTHUR F. WOODFORD, 68, secretary, Sessions Foundry Co., Bristol, Conn., died at his home recently. Mr. Woodford was born in Bristol on Nov. 13, 1866, and received his education in the schools of that city. In 1883 he entered the employ of the Sessions Foundry Co. and worked his way up to become director and secretary of that organization. He was also a director of the Northside Bank & Trust Co. and a former director of the Bristol chamber of commerce.

• • •

James M. Triggs, 64, president, Majestic Furnace Co., Huntington, Ind., died Feb. 17 at his home in Huntington.

• • •

William W. Hutton, 70, vice president and superintendent of the Albion Foundry Co., Albion, Mich., died recently.

• • •

Lester F. Thurber, 76, president, White Mountain Freezer Co., and former president of the Co-operative Foundry Co., Nashua, N. H., died in Nashua, Feb. 26.

• • •

Frank Howell, 63, salesman for the Youngstown Foundry & Machine Co., Youngstown, O., died at his home Feb. 13. Mr. Howell formerly was associated with the Thomas Steel Co.

• • •

Ralph C. White, 67, treasurer, Struthers-Wells Co., Warren, Pa., died recently at his home in Warren. He had been a resident of Titusville, Pa., until 1920 when he entered the employ of that company.

• • •

Martin L. Johnson, 52, for a number of years connected with the Reading Steel Casting Co., Reading, Pa., as sales manager and previous to that with the Detroit Steel Casting Co., Detroit, died Feb. 20 at his home in Wyomissing, a suburb of Reading.

• • •

Alexander M. Thompson, 80, one of the organizers and second president of the Chicago Foundrymen's association, died at the home of his daughter in Kane, Pa., Feb. 15. After serving his time as a molder in Scotland, Mr. Thompson settled in Chicago where he secured employment with the Pullman Co. Later for a period of 17 years he was foundry superintendent for the Link-Belt Co. Other connections included 2 years with the Dayton Motor Car. Co., Caldwell & Sons, Chicago and Campbell, Wyant & Cannon, Muskegon, Mich. He retired several years ago, but always maintained a lively interest in the industry to which he had devoted a long life.

• • •

Fred Graff, 71, founder of the Milwaukee Malleable & Gray Iron Co., and the old South Side Malleable Iron Co., died Feb. 6 at his home in Milwaukee. Mr. Graff was a native of Milwaukee and served as foundry superintendent of the Northwestern Malleable Iron Co., for 25 years.

• • •

Frank D. Bumbaugh, 71, president of the Monessen Foundry & Machine Co., Monessen, Pa., died at Monessen, Feb. 2. He was a pioneer citizen of the city and established the foundry and machine company in 1898 with his brother, the late W. S. Bumbaugh. He served as a member of the Monessen, Pa., school board for the past 30 years.

• • •

John F. Kent, 69, at one time vice president and general manager of the American Cast Iron Pipe Co., Birmingham, Ala., died Feb. 15. Mr. Kent also was former plant manager at the Ensley plant of the Tennessee Coal, Iron & Railroad Co. Before his Birmingham associations, he was connected with the Jones & Laughlin Steel Corp., Pittsburgh, Lorain Steel Co., Johnstown, Pa., and the Dominion Iron & Steel Co., Sydney, N. S.

• • •

George B. McDonald, 65, general superintendent, G. A. Kelly Plow Co., Longview, Texas, died Feb. 6 at his home. Mr. McDonald became connected with that company about 40 years ago when it was located at Jefferson, Texas, and he moved to Longview when the company was moved to that city about 20 years ago. In his capacity of superintendent he had charge of all mechanical work of the foundry and the plant.

• • •

Harry B. Gillespie, 77, former vice president, Michigan Stove Co., Detroit, died Feb. 15. Mr. Gillespie was born in Pittsburgh, April 20, 1858, and was educated in the public schools of that city and at the Professr Titzell academy, Zelienople, Pa. In 1880 he entered the employ of the Michigan Stove Co. as an invoice clerk and later became successively secretary, advertising director, vice president and treasurer. He served as a director for 21 years and when the company was consolidated with the Detroit Stove Works, in 1925, he retired from business.

• • •

Walter G. Nagle, 44, for the past 16 years president of the Baker-Nagle Co., Belleville, Ill., died at Bloomington, Ill., recently while on a business trip. Mr. Nagle was born in Lennox, Mass. During the war he was sent to Scott Field, Ill., as a flying instructor, and at the close of the war became treasurer of the Baker Stove Works, which later changed its name to the Baker-Nagle Co.

• • •

I. E. McGowan, 56, vice president, Sparta Foundry Co., Sparta, Mich., died recently at Santa Monica, Calif., while on a pleasure trip. Mr. McGowan went to Sparta in 1925 from Muskegon, Mich., where he had been connected for several years with the Sealed Power Corp., to become chief metallurgist of the foundry at the time of its organization. He later served as general manager and secretary-treasurer.

Book Review

Atlas Metallographicus, Nos. 10 and 11, by Hanemann and Schrader, paper, 41 pages and 24 pages respectively, 7½ x 11 inches, published by Gebrueder Borntraeger, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, and in Europe by the Penton Publishing Co. Ltd., London.

These books are parts of a series which, when completed, will be a compendium on the metallography of iron, steel, and nonferrous metals and alloys. Part No. 10 discusses fine separations or segregations in unworked alpha iron, describing the two formative processes as tertiary cementite and iron nitride and structural appearance according to the *working* received by iron and steel. The latter is divided evidently into several parts of which cold-working only is partly covered in this section No. 10. The remainder of the book is devoted to eight tables giving data and micrographs on influence of cooling speed on pearlite annealing; formation of particularly fine pearlite; behavior of hypereutectic steel with pearlite annealing, etc.

Part No. 11 is continuation of the tables previously mentioned as included in part No. 10 and contains seven tables. These deal with the change of ferrite; iron nitride; slip planes in ferrite; structural appearance in ferrite with form change through blows (hammer); cold rolled steel examined in the direction of rolling, perpendicular to direction of rolling, and across the section, and structural changes in wrought steel under tension. The text is in German.

"BRANFORD" VIBRATORS

Vibrator Flask Rapper
(above)

Vibrators for all Foundry uses
From 3/8" Plate Vibrators
to
8" Flask and Table Vibrators.

Valves, Fittings, Automatic Oilers—Complete Vibrator Fittings for Benches, Moulding Machines and Tubs.

New Department for Servicing Branford and Any Other Make of Pneumatic Vibrators.

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MALLEABLE IRON FITTINGS CO.
Branford, Conn., U. S. A.

Auto Malleables
Plumbing Goods
Stove Burners
Manifolds
Pipe Fittings
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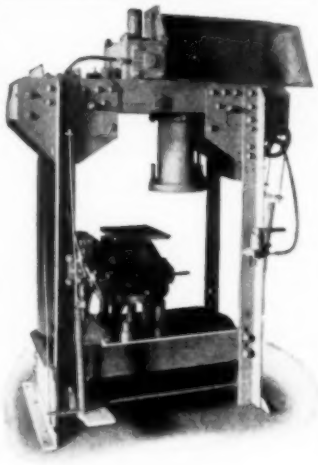


Cores for the above castings are being made universally on our machines, resulting in greatly increased production and better cores.

We have a machine for your job.

Your Correspondence Solicited

Wm. Demmler & Bros.
Kewanee, Illinois

MOGUL

Reg. U. S. Pat. Off.

Distinctly *Superior* in Results and Economy

• ▼ •

Made by an original and unique process, MOGUL is a perfect green sand bond for facings. It produces maximum strength but simultaneously gives natural vents in the sand.

Our experienced and practical foundrymen can prove to your satisfaction MOGUL is all we claim for it.

• ▼ •

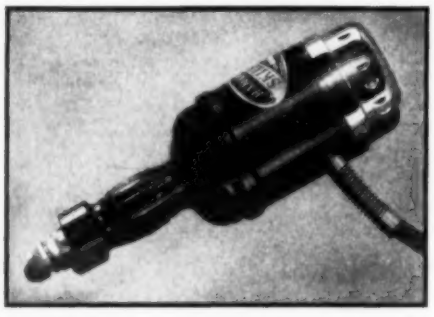
CORN PRODUCTS REFINING CO.
17 Battery Place, New York, N. Y.

New Equipment

For Foundries

Portable Grinder Has Built-in Air Filter

Skilsaw Inc., 3310 Elston avenue, Chicago, has introduced a portable electric hand grinder, as shown in the accompanying illustration. The motor will deliver a speed of 1800 revolutions per minute and is designed especially with armatures balanced to eliminate vibration, and with the



An air filter protects the unit from dirt in the cooling air

field and armature windings baked in bakelite. The motor will operate either on direct current or alternating current. A special fan pulls air through the tool for cooling. An air filter at the intake protects the unit from dust and dirt.

Electric Elevating Truck Is Streamlined

Baker-Raulang Co., Cleveland, has introduced a new two-wheel drive, four-wheel steer, 3-ton elevating truck incorporating several interesting features of design. A streamlined enclosure is provided for the battery box and controls, not only to improve appearance, but to increase safety for the operator in eliminating protruding units or parts against which he can be thrown in event of the truck's hitting some obstruction.

Other features of design claimed for the unit include an electrically welded frame of high carbon steel, alloy steel trailing axle of high strength, larger travel brakes than on previous models, roller bearings at top and bottom of steering mast and needle bearings in many of the steering rod connections for increased ease of steering, higher travel speed, and a sponge rubber pad on the operator's platform to decrease fatigue under long hours of continuous operation.

Builds Potentiometer

Brown Instrument Co., Philadelphia, has introduced a new portable potentiometer designed for checking potentiometers, millivoltmeters and thermocouples quickly and accurately. A combination of a step-switch and slide wire makes it possible to read the indicating scale to 0.01 millivolts over a total range of 71 millivolts. The step-switch and slide wire combination is equivalent to having a slide wire 109 inches long. The indicating scale is 17 inches long, making the smallest scale division over 1/16-inch in width. A fully enclosed, suspension type galvanometer is used.

Coating Protects Burns

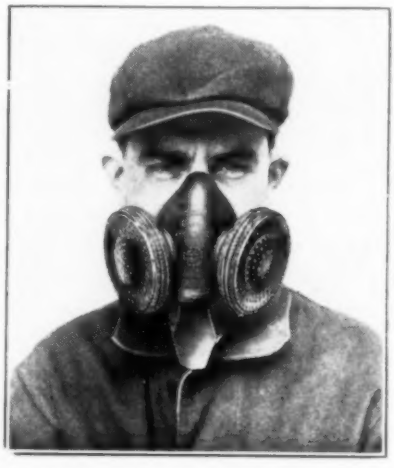
Burroughs Wellcome & Co., 9 East Forty-first street, New York, has introduced a tannic acid jelly known as Tannafax which is suitable for treating first, second and third degree burns and scalds.

The material is non-oily and non-greasy and has a water soluble base that can easily be bathed off when subsequent treatment demands the removal of dead tissue. The material is applied in the form of thin coating, and after two or three applications at 20-minute intervals, a tough, scab-like coagulum forms over the injured surface. A phenol content is claimed to provide sterility and give a dual antiseptic and analgesic action.

E. G. Allen, Cleveland, has been appointed to the sales staff of the Certified Core Oil & Mfg. Co., Chicago. For the past 17 years Mr. Allen was associated with Spencer Kellogg & Sons Co., Buffalo.

Light Weight a Feature of Respirator

Mine Safety Appliance Co., Braddock, Thomas and Meade streets, Pittsburgh, has introduced a new respirator which, it is claimed, com-



Filter cases are of aluminum and the face piece is of light rubber

bines efficiency in dust stoppage with comfort to the wearer.

The construction of the respirator, shown in use in the accompanying illustration, is simple. A complete respirator weighs only 4.8 ounces, and is easily and quickly adjusted to the head.

Both to impart light weight and to facilitate sanitation, the filter cases have been made of aluminum. These and the light rubber face piece may be washed and disinfected.

Maintenance of the respirator requires the renewal of filter disks as they become impregnated with dust, which is indicated by a gradual increase in breathing resistance. The disk is replaced by unscrewing the perforated lids of the filter and inserting a new filter in its place.

Sales representatives of the Moltrup Steel Products Co., Beaver Falls, Pa., gathered held an annual conference in Beaver Falls, Feb. 2. Optimism dominated opinions regarding the business outlook.

The Ideal Material for Sand Blasting

. . . . . it cleans fast

. . . . . *at reduced cost*

FLINT SHOT gives a class of finish impossible to duplicate with any other forms of abrasives. It's round, pearlike granules are as hard and sharp as flint. Does not split up, only wears down and can be used over and over again many times. It flows freely, requiring less air power. FLINT SHOT LASTS. Relatively dustless.

Try FLINT SHOT and you'll be convinced.

Engineering Service Gratis.

Three plants to meet your needs with dispatch.

Washed, Dried and Screened Special Sands for

Steel Moulding

Furnace Bottoms

Cores, Openers

And Silica Flour.

OTTAWA SILICA COMPANY

Ottawa, Illinois

RUEMELIN SAND BLAST CABINETS

(Patented)

Have proven most practical in service. More than 500 in use — Durably constructed — Lowest Maintenance cost — Simple to operate — Moderately priced — Sanitary in operation.

Showing cabinet with Front door closed

The large front door swings open for quick access to inside of cabinet.

• •

No time is wasted as operator is not required to walk to rear of cabinet for loading or unloading.

Particularly well adapted to the requirements of brass and aluminum foundries.

• •

Get our quotations on Cloth Bag Dust Filters, Sand Blast Rooms, Generators, Abrasive elevators.

RUEMELIN MFG. CO.

1587 S. First St. **Milwaukee, Wis.**

FEDERAL
TWISTED STEM
CHAPLETS

Sharp Edges for Fusion

Not a Weakened Deformed Stem

Ideal for Pressure Castings

Heads Electrically Welded

Cost No More than other chaplets

THE FEDERAL FOUNDRY SUPPLY CO.

4600 East 71st St. (Station D)

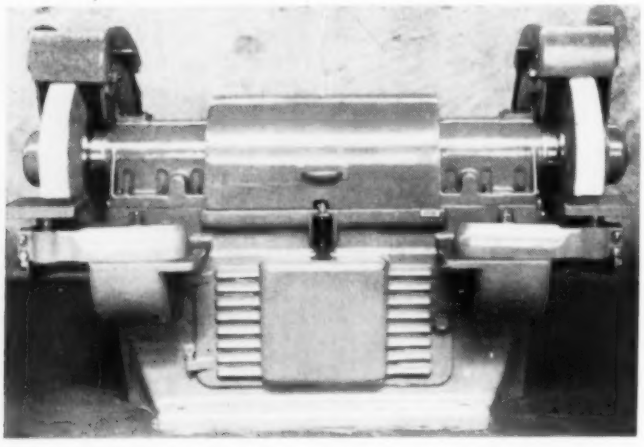
CLEVELAND, OHIO

New York, Detroit, Chicago, St. Louis, Milwaukee, Minneapolis

Floor Grinder Has Three Speed Changes

Bridgeport Safety Emery Wheel Co. Inc., Bridgeport, Conn., has introduced a new high speed, floor grinder, shown in the accompanying illustration. The machine uses 24 x 4 x 12-inch grinding wheels, and has three speed changes at regular intervals which produce a maximum wheel surface speed of 9500 feet per minute and a minimum surface speed of 8000 feet per minute. With that arrangement the wheels can be used down to 15 inches in diameter, eliminating wheel changing until that point.

Speeds are governed by the spark breakers which should always be maintained in close proximity to the grinding wheels. Speed change is governed by the largest wheel, and when it reaches the point where a change should be made, an alarm is sounded which informs the operator that the belts must be shifted to the next higher speed.



Speed change is governed by the diameter of the largest grinding wheel

The mechanism is interlocking so that according to the manufacturer, it is impossible to speed the largest wheel faster than 9500 surface feet per minute.

Develops Unit Heater

Young Radiator Co., Racine, Wis., has introduced a line of unit heaters having straight fins and elliptical copper tubes in the core or heat transfer surface. Straight fins permit the air to pass through the core in a straight line and the elliptical tubes provide a large heating surface in contact with the passage of air. Heaters are designed to circulate a large volume of heated air at high velocity with a low outlet temperature.

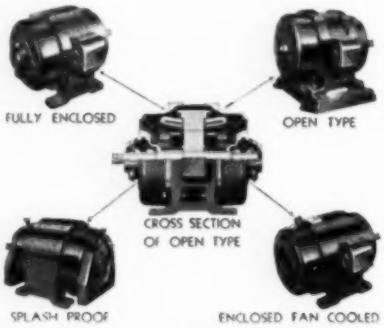
The design of the unit heater permits the heat to be directed down into the working area. The unit is suspended from the ceiling and all piping can be placed overhead where it is easily accessible.

Induction Motors Have Convertible Feature

Harnischfeger Corp., West National avenue, Milwaukee, has introduced a new line of convertible squirrel cage and slip ring induction motors, designed with standard frequencies for service ranging from 110 to 220 volts. A feature of the new motors is the fact they may be converted from open type to fan cooled, splash proof or totally enclosed construction. This is accomplished through the design of the frame, end heads and bearings to permit interchangeability in the four types of single or multi-speed squirrel cage and slip ring motors. The stator laminations are stacked between heavy steel end rings and the entire assembly is welded to the frame. Rotor windings are assembled from round or rectangular hard drawn copper bars placed in the rotor slots without insulation or wedges. The ends of the bars are brazed to the end rings by an electric arc torch.

Acid Resisting Cement

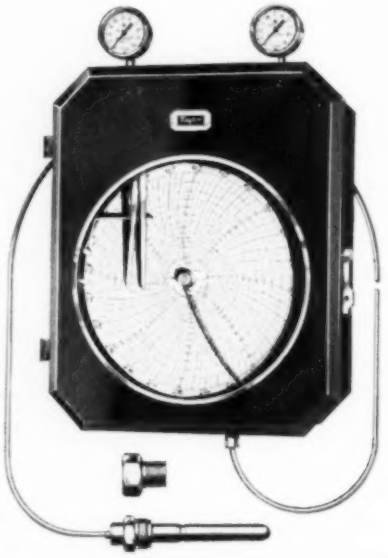
Technical Products Co., Freeport road, Pittsburgh, has introduced an acid-resisting cement which, it is claimed, will harden by setting within 36 hours. It is said that the cement will also resist water, fumes, and many other solvents including fire.



Design permits interchangeability in the four types of motors

Recording Regulator Handles Several Factors

Taylor Instrument Co., Rochester, N. Y., has introduced a new recording regulator for temperature, pressure, rate of flow and liquid level. A high degree of accuracy is produced by a new lightweight duralumin mechanism, practically frictionless bearings, and other simplifications and refinements of design. Regulator action can be converted easily and quickly from direct to reverse or vice versa without addition or subtraction of parts. Temperature or pressure regulators are adaptable to applications requiring a different temperature or pressure range by simply substituting a tube system and chart with the required range.

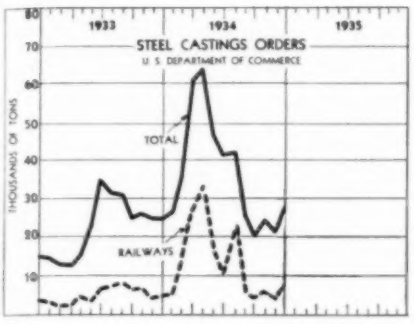


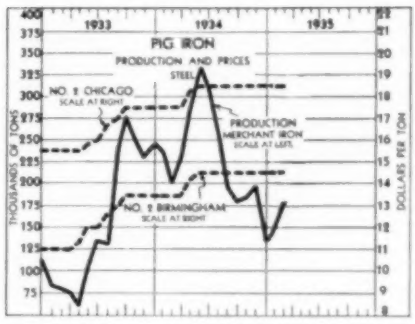
Regulator action can be converted quickly from direct to reverse and vice versa

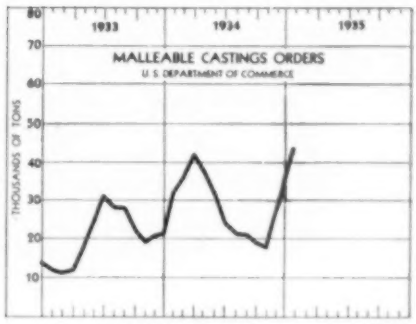
Control is maintained in the conventional manner by regulating the flow of air pressure to the diaphragm valve in the controlling medium line in response to changes in apparatus under control. A constant 25-pound air pressure supply for actuating the diaphragm valve is recommended.

Elevating Truck Handles Low Skids

Barrett-Cravens Co., 3255 West Thirtieth street, Chicago, has introduced a new hand-operated elevating truck for handling materials on low 4-inch skids. The truck is only 3½-inches high in the lowered position, is 15-inches wide, has a 24-inch carrying frame and a 5-inch clearance between the forks. The unit is capable of lifting loads up to 3500 pounds, a distance of 2¼-inches from the floor. Ball bearings are used throughout.







Foundry Activities

Reflect Industrial Trends

DESPITE occasional reductions in schedules of smaller plants, foundry operations were well maintained in the Chicago district during February. Melters supplying the automotive and farm implement industries continued to experience the best production. Automotive demand is expected to hold at its recent rate through March, while some implement interests are behind on deliveries and anticipate better operations than recently in the second quarter. Daily rate of pig iron shipments last month was the highest in eight months, with deliveries of foundry coke in the best volume in nearly 5 years. Steel foundry schedules still lag behind the melt of gray iron and malleable plants. Orders for railroad castings increased slightly last month but still are light. Activity among producers of plumbing and radiation castings improved moderately.

* * *

Ralph Jones has established an iron foundry at Mullins, S. C.

* * *

Lakeside Foundry Co. Ltd., Port Colborne, Ont. recently has been organized. W. L. Spence is acting manager.

* * *

Wise Furnace Co., Akron, O., has resumed operations after being idle for two months.

* * *

Brass foundry of the Tennessee Polytechnic institute, Cookeville, Tenn., recently was destroyed by fire with a loss of approximately $20,000.

* * *

Overmyer Mould Co. of Pennsylvania, Greensburg, Pa., has been granted a state charter with $50,000 capital stock to manufacture molds, castings and machinery by K. R. Haley, C. L. Mentch and M. Longnecker, Greensburg, Pa.

* * *

D. W. Clark Brass Foundry, 529 East Seventh street, South Boston, Mass., recently was slightly damaged by fire.

* * *

James F. Powers Foundry Co., 206 Bridge street, Elkton, Md., expects to put its plant in operation soon, after being idle since 1931. G. A. Allender is president, John B. Morrow, vice president, William J. Fenton, secretary and Thomas B. Miller, treasurer.

* * *

Dominion Foundries & Steel Ltd., Hamilton, Ont. will erect an addition to its plant at Toronto, Ont. to cost $15,000.

* * *

Springfield Foundry Co., Springfield, Mass., has been in business for over 80 years. While established at an earlier date, the company was incorporated in 1877.

* * *

Des Moines Stove Repair Co., Des Moines, Iowa, recently has established a heating and air conditioning department. J. B. Green is president of the company which was established as a small jobbing foundry in 1869.

* * *

Eastern Steel Castings Co., Newark, N. J. celebrated its twenty-fifth anniversary on March 10. The company was organized as the Bayonne Steel Castings Co., Bayonne, N. J., and was changed to the Eastern Steel Castings Co., when the plant was moved to Newark in 1923.

* * *

Auburn Foundry, Inc., Auburn, Ind., recently received a loan of $20,000 from the Reconstruction Finance Corp. The corporation also loaned $12,000 to A. P. Williams Iron & Bronze Co. Inc., New York, and $60,000 to the Milwaukee Steel Foundry Co., Milwaukee.

* * *

Werra Aluminum Foundry Co., Waukesha, Wis., has been placed in friendly receivership with a view of forming a new corporation to take over the assets and continue the business. Julius Werra will head the new company,

RAW MATERIAL PRICES
March 6, 1935

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	14.50
No. 2 foundry, Chicago	18.50
No. 2 foundry, Buffalo	18.50
Basic, Buffalo	17.50
Basic, Valley	18.00
Malleable, Chicago	18.50
Malleable, Buffalo	19.00
Charcoal iron, furnace	21.00
Coke	
Connellsville beehive premium	$ 5.10 to $ 5.35
Wise county beehive coke	4.30 to 5.30
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$13.00 to $13.25
Heavy melting steel, Pitts	12.50 to 13.00
Heavy melting steel, Chicago	10.50 to 11.00
Stove plate, Buffalo	9.25 to 9.75
Stove plate, Chicago	6.50 to 7.00
No. 1 cast, New York	7.00 to 7.25
No. 1 cast, mchy., Chicago	9.50 to 10.00
No. 1 cast, Pittsburgh	13.00 to 13.50
No. 1 cast, Philadelphia	11.50 to 12.00
No. 1 cast, Birmingham	9.50 to 10.00
Car wheels, iron, Pittsburgh	12.00 to 12.50
Car wheels, iron, Chicago	11.00 to 11.50
Railroad malleable, Chicago	13.25 to 13.75
Malleable, Buffalo	12.50 to 13.00
Nonferrous Metals	
	Cents per pound
Castings copper, refinery	7.50 to 7.75
Straits tin	46.60
Aluminum, 99 per cent	19.00 to 21.00
Aluminum, No. 12 (Secondary)	16.00 to 17.00
Lead, New York	3.55
Antimony, New York	14.50
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	3.90

and Bruno Werra, the production, research, and metallurgical divisions.

* * *

Index of foundry equipment orders for January, according to a recent report of the Foundry Equipment Manufacturers' association, Cleveland, was 86.6 as compared with 66.9 in December, 1934 and 37.2 in January, 1934. Index of shipments for the first month of this year was 76.2 and index of unfilled orders, 69.2.

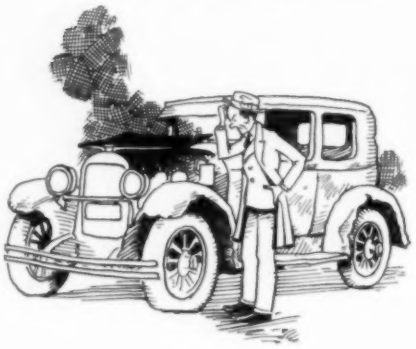
* * *

McCallum-Hatch Bronze Co., Inc., Buffalo, has acquired the business of William H. Barr, Inc., brass founders, 27 Carolina street, Buffalo. The new company will continue the business with the same personnel and operating staff. John C. McCallum is president and treasurer, James A. Hatch, vice president and sales manager, and William F. Hagedorn, secretary.

* * *

Foundry activity in the Philadelphia Federal Reserve district increased during January for the second consecutive month, according to a report of the Industrial Research department of the University of Pennsylvania. Gray iron production increased 9 per cent; malleable iron production, 25 per cent; and steel casting production, 28 per cent.

Faked Foundry Facts



Shot Iron

New Trade Publications

CHARCOAL IRON—An interesting booklet on the use of charcoal iron in the foundry has been published by the Superior Charcoal Iron Co., Grand Rapids, Mich. The discussion includes a brief historical reference to the use of charcoal iron, the characteristics of that metal, special irons and the grades of charcoal pig iron made by that company.

VALVES—Tuthill Pump Co., 131 West Sixty-third street, Chicago, has published a folder on its new relief valve for industrial use. Features and advantages are discussed, and illustrations show the construction of the unit.

SEALS—National Motor Bearing Co. Inc., 1100 Seventy-eighth avenue, Oakland, Calif., has published a booklet on its line of oil and fluid seals. Illustrations and text present the construction and application of the seals.

ELECTRIC WELDING—General Electric Co., Schenectady, N. Y., has published two bulletins, one devoted to information on its line of arc welders and the other discussing welding electrodes and accessories.

SAND EQUIPMENT—Harry W. Dietert Co., 676 West Grand boulevard, Detroit, has published several folders on new sand testing equipmnt, including a sand sample tray, a moisture teller, and a discussion of a mold control formula.

CRANES—Cleveland Crane & Engineering Co., Wickliffe, O., has published a folder on its line of tramrail cranes and transfer bridges. Illustrations show the application of that equipment to a wide variety of industries, including the handling of molten metal in the foundry.

MALLEABLE CASTINGS — Chain Belt Co., 1600 West Bruce street, Milwaukee, has published a bulletin discussing its facilities and experience in the production of malleable iron castings. Illustrations show numerous types of castings produced.

SAND MIXERS—A foundry sand mixer for preparing facing sand or core sand is described and illustrated in a recent bulletin of the Baker Perkins Co., Saginaw, Mich. Features of design and operation as well as size of units available are discussed.

GAS CUTTING—Linde Air Products Co., New York, recently has published two booklets, one a completely revised edition of "Precautions and Safe Practices" and the other entitled "Recommended Practices for Gas Cutting of Structural Steel." The former deals with precautions and safe practices in the storage, care and handling of oxyacetylene welding and cutting equipment.

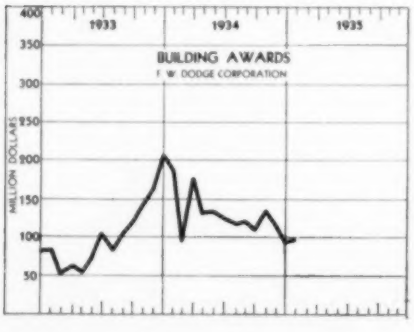
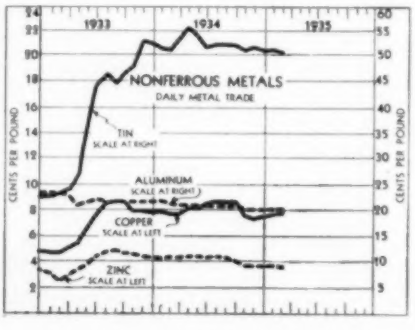
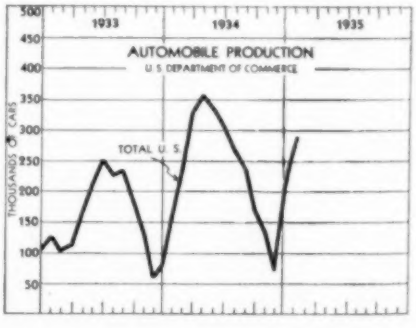
ELECTRODES—Air Reduction Sales Co., 60 East Forty-second street, New York, has published a folder on its shielded arc electrodes. Information includes recommended current values for various positions and reproductions of specimens of welds made with that type of electrode.

PYROMETER — An immersion pyrometer for nonferrous metals is described and illustrated in a recent bulletin of the Pyrometer Instrument Co., 103 Lafayette street, New York. Features of design, instructions for use and specifications of the instrument are presented.

FILTRATIONS—Carl Schleicher & Schull Co., 167 East Seventy-third street, New York, has published a second and enlarged edition of "Filtrations in Chemical Laboratories," a handbook on filtering operations for the chemist. An appendix gives large-scale production filtrations in manufacturing plants.

TURBINES — General Electric Co., Schenectady, N. Y., recently has issued three bulletins dealing with turbines for mechanical drive. These include single stage steam turbines, 40 to 400 horsepower, noncondensing; multistage steam turbine, 100 to 2000 horsepower, condensing or noncondensing; steam extraction, multiport valve gear.

COMPRESSORS—Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, has published bulletin 728 on horizontal, single-stage compressors. Through text and illustrations, the various features of design and construction are stressed. Compressors with several different types of drives are illustrated.

BLOWERS — Roots - Connersville Blower Corp., Connersville, Ind., has issued a bulletin illustrating and describing the standard and heavy duty types of blowers made by that company. Information is given on the inherent characteristics and the operating principles of the rotary positive type of blower, while illustrations show typical installations.

PYROMETERS—C. J. Tagliabue Mfg. Co., Park and Nostrand avenue, Brooklyn, N. Y., has published a booket covering a new recording potentiometer, an indicating potentiometer controller, a nonhunting, nondrifting recorder-controller photoelectrically balanced, and indicating and recording pyrometers. Features of the various units are discussed.